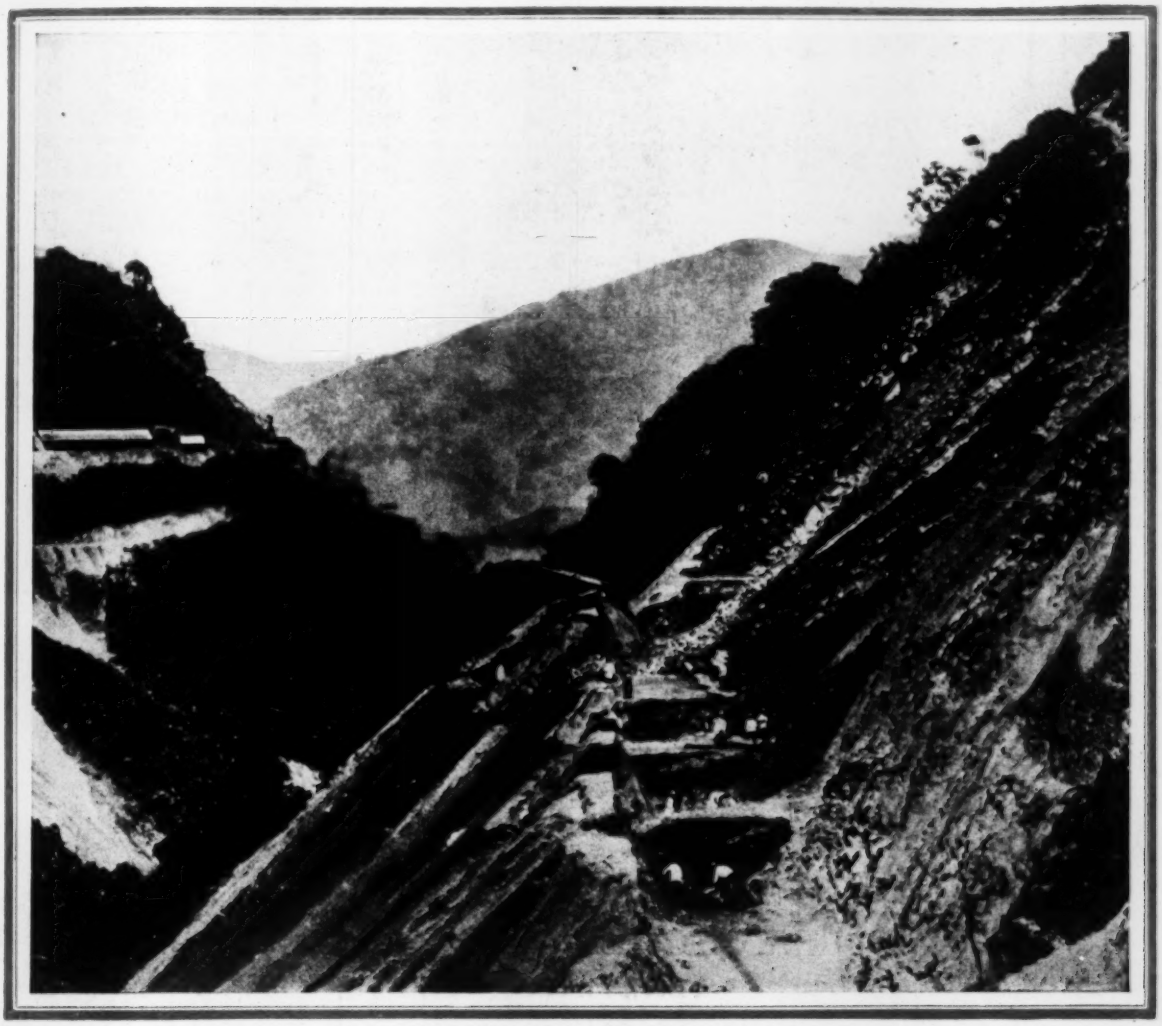
October 15, 1925

Engineering News-Record

Devoted to Civil Engineering and Contracting. McGraw-Hill Company, Inc.



Typical Grading on the Amaga Railway, Colombia

Building the Amaga Railway Extension in Colombia

Double Deck Street Structures, South Water Street, Chicago

Trouble with Waterweed in Open Shallow Reservoirs

Survey Shows How Niagara Falls is Receding

Review of Recent Engineering Literature

World Theatre, Omaha, Nebraska. Roofed for permanence with Federal flat slabs. C. Howard Crane, Architect.

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ENGINEERING NEWS-RECORD

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

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A Word to the Wise

IN HIS powerful plea for tolerance made before the American Legion last week the President gave voice to one thought that engineers might consider as engineers as well as men. "Progress," said Mr. Coolidge, "depends very largely on the encouragement of variety. Whatever tends to standardize the community, to establish fixed and rigid modes of thought, tends to fossilize society. If we all believed the same thing and thought the same thoughts and applied the same valuations to all the occurrences about us, we should reach a state of equilibrium closely akin to an intellectual and spiritual paralysis." Applying this to the materialistic world instead of to the behavioristic for which it was intended there is food for thought in this day of standardization. A certain amount of similarity of design and of pattern and of type is necessary, but in our enthusiasm let us not go too far and reduce engineering to the fossilized equilibrium that the President so clearly foresees for similar regimentation in the realm of thought and behavior.

A Chance for the Engineer Student

UNDERGRADUATE engineering students in colleges or universities anywhere in the United States that provide direct instruction in municipal government might find it worth their while to consider entering competition for the Baldwin prize for the year 1926. Two of the subjects are particularly appropriate for any student in the municipal field and the third subject could well be taken up by students who are specializing in sanitary engineering as also by students, whether engineers or not, who are taking courses in public health. The first two subjects indicated are Bonds vs. Pay-as-You-Go Plan for Financing Permanent Improvements and Application and Administration of Special Assessments. The third subject is Administration of Local Health Service.

Corn Snow Fences

ON ONE Minnesota trunk line highway every farmer who has grown corn this season has left standing eight rows, 50 ft. from the road, to serve as a snow fence. In many a past winter, in the plains states, corn has successfully tided over the crisis of a fuel shortage, but providing a snow fence is a new cold-weather service for this distinctly American cereal. And its possibilities for this service may not be regarded with ridicule. Highway engineers who have been studying snowfall and snow removal along more scientific lines are drawing together in the conviction that drift prevention and control and not a mighty outfit of snow plows is the way to keep our public roads open for traffic in winter. Drift prevention and control are a problem of providing suitable wind breaks and natural growths offer greater possibilities for development on most highways than do artificial snow fences, and the natural growth is generally the better wind break. The fact that a group of Minnesota farmers is volunteering to co-operate with the state road department and other agencies in keeping main routes open in winter indicates how far the motor vehicle has carried the doctrine of year-around highways. It often seems in our northern country an expensive ideal, and it does cost high to keep the snow off, but it must not be overlooked that every winter road kept open adds to the motor vehicle mileage and so adds to the gasoline tax income which is helping so greatly to build and keep up public roads.

A Super-Street

FEW street improvements guarantee greater relief of traffic congestion than the double-deck roadway on South Water St., Chicago, described in this issue. It finishes and makes operative the quadrilateral of wide streets by which through traffic can bypass the business section of Chicago—the "Loop." Counts are not at hand of vehicle movements in the Chicago "Loop" but they are exceeded in only a few of the most congested urban districts of the world. And of all these vehicles one in four is in the "Loop" only to pass through without stop. This quarter of all vehicles using the "Loop" streets is removed from them by the new double-deck street. Besides, it eliminates the old South Water St. produce market. Counts several years ago showed over 16,000 market vehicle movements in the Loop streets—movements of vehicles in the "Loop" only to get to and away from the South Water St. market. With the double-deck street completed these 16,000 vehicle movements will no longer help to congest Loop traffic. These are only two major items of traffic relief which the quadrangle of wide streets will accomplish. Altogether it is estimated that congestion in the district between 16th St., the river and the lake will be cut down 40 per cent. As the future will appraise such works it is doubtful if Chicago has ever accomplished any more worth-while city improvement.

Price Paramount

SPEAKING of shield tunneling a great tunnel builder not long ago remarked that devices and methods had not changed fundamentally in a decade but the finesse of tunneling had vastly improved. This in greater or less measure is the situation with respect to all construction. As more operations are machine performed and as machines are improved there is less opportunity for new contrivance in equipment and processes and progress has to take the path of developing finesse. It is not a quality easily defined but no one trained in construction fails to sense its presence or absence. Two building or dam or road jobs may register alike in every essential of equipment and methods

and yet one expresses a refinement of skill which makes the other seem awkwardly handled. Still there is no recognition of construction finesse in letting contracts. The owner feeling secure in his engineer or architect and his plans, specifications and inspection, and insured by the bonding company, picks his builder according to price. In public works the lowest bidder controls the situation by statute. On both hands the contractor is kept from capitalizing construction finesse except as it may help him to bid lower. There is perhaps no other business in which this condition exists. It is *sui generis* with contracting. It is a stinging commentary on engineering intelligence and contracting common sense that these alone of all vocations, in their business dealings together, make price the fundamental requirement and then wage continual battle over quality.

Road Fires

BURNING up the road is no longer confined to hyperbole in its significance. The modest citizen who stays at home Saturday afternoon and rakes the leaves off his lawn and burns them in the roadway is being called to account for setting fire to bituminous and tarred roads. In Connecticut the highway authorities have told the state police to pounce on leaf burners and warn them of punishments to come if they persist in their nefarious practices. So vanish the solaces of life. With old clothes and a pipe, and leaning on a rake to watch leaves burn in the autumn dusk, one could regard equably the deviltries of the speed hound against peace and quiet. Now this is denied, for, say the Connecticut road keepers and truly say, "inasmuch as many roads are treated with asphalt, tar or other substances which contain volatile oil, easily ignited, a serious menace exists." Even though the fires are started in the gutters, it is asserted that the heat from them is sufficient to draw the oils from the bituminous surface of the highway and cause a greatly increased maintenance expense. Reasons so worthy extend true comfort for self-denial and there are possible compensations otherwise—the Connecticut officials say that traveling with leaky gas tanks over smouldering remains of leaf fires frequently causes explosions.

A Great Construction Report

LEISURELY reading of the latest "technical report" of the engineers of the Miami Conservancy District emphasizes again the value of this large task of technical book production in conjunction with the work of designing and building a forty-million-dollar engineering works to protect a great river valley from floods. With the volume on construction, now in hand, there have been published ten technical reports embracing investigations, in connection with the flood works, in hydrography, stream hydraulics, dam and channel design and, finally, construction methods and costs. These volumes generally have had high technical value. It is the final volume, however, which is unusual. Ordinarily in publications of similar genesis, construction plant methods and costs are much subordinated to discussions of design and structure. Here these subjects are given a more extended discussion than most of the other subjects of the nine preceding technical reports. Its authorship lends it increased value. Coming from the successful construction by direct labor of the great Arrowrock Dam, Chas. H. Paul had closer touch with the construction of the Miami Valley flood works than any other person except perhaps Chas. H. Locher the veteran contractor, who was the construction manager. The problems these men had to meet, how they elected to meet them, why the adopted machines and processes were employed and what the results were as expressed by performance and cost figures are told fully in the report now completed. It is the contractors' and construction engineers' particular share of the ten technical publications of the Miami Conservancy District engineers and directors.

Construction Admonition

PURVEYORS of admonition, whether individuals or associations, are usually rewarded by being called a nuisance. Therefore, these admonitions put forth by the Associated General Contractors are not expected to run otherwise than true to form. It is a pity that it should be so because they hold a world of possibilities for stabilizing contracting. They are:

> Public Officials: Don't let a contract unless you know that the successful bidder has the resources to complete it. Don't let a contract at a price below an intelligent estimate of cost plus a reasonable profit.
>
> Surety Companies: Don't bond a contractor unless you know he has the experience, financial resources and the physical equipment necessary to fulfill the contract.
>
> Contractors: Refrain from bidding on contracts which you do not have the equipment or resources to handle. Don't undertake any job at an unprofitable price.

All of this advice is excellent and all of it should be followed and straightway the query arises: How can one tell when prices are right and contractors are responsible? None of the construction agencies addressed does the things it is warned against, deliberately and consciously. It doesn't know, and so in gross ignorance, or because it relishes the gamble, it takes a chance. More knowledge is the first requisite for stabilizing contracting—more knowledge of costs and market conditions by contractors and knowledge how to determine responsibility and skill by owners and sureties. It is, perhaps, the most hopeful sign of the construction business today that engineers and contractors and surety companies are so widely, through their committees and joint committees, seeking to gather this knowledge.

More Befuddlement on Muscle Shoals

WE ARE in for another exciting and probably unproductive debate in Congress next session over Muscle Shoals, if the recent public pronunciamento of Chairman McKenzie of the President's Muscle Shoals Commission is any indication of the views of the majority of that commission. Mr. McKenzie's press release is a most amazing thing to come from a man who is supposed to be in the judicial position of helping to determine what is best to do with a large government property and who is part of a board that has not as yet heard all the evidence or completed its deliberations. His outburst is the most violent plea for government ownership that has been heard from anyone in authority, not excepting Senator Norris who has advocated such a course for some time. Mr. McKenzie says that

he will work up a plan of government ownership and operation of the power and nitrate properties, because of the "indifference of private interests and their failure to co-operate." This is obviously a loosely worded charge, for private interests have been far from indifferent and Mr. McKenzie nowhere has specified wherein "co-operation" lies. Almost simultaneously there has been made public a serious report by Major Max C. Tyler, Corps of Engineers, giving considered data on Muscle Shoals power and chemical possibilities This is a useful document, for it shows, what Mr. McKenzie chooses to disregard, a ratio of approximately 4½ to 1 in favor of a wide distribution of power in diversified industry and agriculture over an isolated operation for either chemical production or power production of the plants at Muscle Shoals. In other words the engineer knows what diversified load means; the politician chooses to assume that electricity is something that can be turned out of a plant all day and all night and stored up in some sort of pool to be used as required. So long as there is the popular notion that a single water-power plant can be built wherever there is occasional flow of water and made to supply electrical energy, by itself alone, as continuously and cheaply as can a steam plant or a combination of steam and hydro plants, just so long will the popular mind continue to be befuddled about the proper disposition of our water power—and of Muscle Shoals.

Productive Athletics

AS SPORTING news the recent effort of a young girl to swim the English Channel commands far more newspaper space than does the contest of paving-brick layers early last month in Kansas. Newspaper editors are keen judges of popular interest and as any contractor can testify young people are more interested in swimming than they are in bricklaying. Yet the two events have points in common.

Both were tests of endurance and in both the participants were forced to quit by outside interference. Miss Ederle, the swimmer, was pulled protesting, from the water by a frightened trainer before she was ready to quit and "Indian Jim," the paver, found, after 6 hours and 46 minutes of work, that the management had underestimated his capacity and had no more bricks for him to lay. He, like the girl swimmer, is mad because accident prevented the full extension of his powers. There is fine subject for the homilist in this defeat by fate. Indeed he might discourse at some length and quite pertinently on the relative usefulness of being able to swim the English Channel and being able to lay 114 paving brick a minute for almost seven hours. However, it seems more important to look at the actual performance record of James Garfield Brown, "Indian Jim," an Oneida Indian and a graduate of Carlisle University and also, incidentally, at the record of his competitor Frank Hoffman of Eldorado, Kan.

Starting back to back these two men laid pavement until the brick supply failed at the end of 6 hours and 46 minutes. Then Indian Jim had laid 46,644 brick and Hoffman had laid 44,889 brick. One had completed 416½ ft. and the other 397 ft. of 32-ft. brick road. Now a paving brick weighs 8½ lb., so that the winning contender handled over 198 tons of brick. This is indulging in athletics to a useful purpose. Now if some one could only rouse the competitive instinct in bricklayers!

Over-Refined Design

ONE of the best criteria of efficient engineering is that it is incumbent to do whatever is to be done as well as need be for the least cost consistent with that end. This principle should be governing in all design. Indeed, theoretically it is but there are times when the competent designer seems to forget it and to become so involved in the so-called economies of design as to forget that design has validity only as the preliminary to construction, that no matter how nice a balance of quantities is made by the careful computation of every element of the structure as represented on paper final economy is determined by the cost of construction. This is so simple a statement of the fundamentals of engineering that it may seem a supererogation to state it but there are recent instances on record which show that some of our best designers are forgetting it. The contractor who has to build the structure the engineer designs knows it, however, and is apt to put it down as a idiosyncracy of engineers in general and another instance of their lack of practicality.

The most flagrant case of recent notice is in the design of a large reinforced-concrete hotel. For some reason not obvious in the drawings the designer has found it desirable to torture the beam layout into a series of odd spacings, varying only by inches, and as a consequence of this irregular spacing has seen fit too to vary the size of the reinforcing bars in successive beams by eighths of inches. Presumably these refinements produce theoretical economies in weight of metal and quantities of concrete or else the designer would not have resorted to them but they also produce tearing of hair on the part of the contractors estimating on the bids and a substantial increase in those bids. For it is so obvious as to be hardly worth the recording that construction economy lies in standardization of sizes just as manufacturing economy lies in standardization of parts. The result on this particular building is that the builder has to resort to expensive formwork to meet the slightly varying spacing and expensive steel laying to take care of the minutely varying rod sizes. And the final result is a cost greater than the theoretical saving from the reduced quantities.

It may be thought that to declaim against such a practice is to knock down a straw man, for the reason that no good engineer has so little consideration for the necessities of construction. The fact remains that at a recent meeting at which some leading building contractors were present this particular instance was cited as one of growing commonness, even in some of our best engineering offices, and that it illustrated the engineering view of construction economy. One contractor even went so far as to say that the man who did it was a good engineer, in fact he was too good an engineer because he applied here the quintessence of engineering theory and figured his design down to the very last hair. Of course, the very opposite is true. To design so that the construction cost is raised is bad engineering and the engineer knows, or should know, that refinements of design which are not reflected in reduced cost are doubly expensive, because they not only add the dollars onto the total expense of the structure but they destroy the contractor's confidence in the engineer's common sense. And in any particular structure it may be difficult to tell which of the two is the most damaging.

Building the Amaga Railway Extension in Colombia

Difficult Construction in the Andes Undertaken by American Contractors with American Engineers Foremen and Machinery—Grading, Bridges and Tunnels—Pay-Day Methods

AN IMPORTANT new railway development in the Republic of Colombia, South America, is the extension of the Amaga Railway west and south to Bolombolo, on the Cauca River, for although this new line is only 25 miles long, it is the first stretch of a larger project and is being built by American contractors, with engineers, foremen, skilled workmen and construction plant imported from the United States. Two views of the grading for this mountain line are shown in Figs. 1 and 3.

The Amaga Ry., owned by the government of the Department of Antioquia, is a line of 36-in. gage running 36 miles west from Medellin, the capital city of the department, through a farming and coffee-growing district, and its principal business is the transportation of coffee. Beyond the present 25-mile extension a further extension of 30 miles up the Cauca River will carry the line through another coffee district to the boundary of the provinces of Antioquia and Caldas, to connect eventually with the Pacific Ry. when the latter is extended down the river from Cali. With such a connection, which will not be made for several years, there would be an outlet to the Pacific Coast.

It is the government's purpose to extend the Amaga Ry. eventually down the Cauca River about 186 miles, and thence either west to a Pacific port or on down the Cauca and Magdalena rivers to an Atlantic port, to eliminate the river steamer route. At present, with coffee brought in over the Amaga Ry. to Medellin as the central coffee market, exporters will ship the coffee from that city over the Antioquia Ry., also owned by the department government, 124 miles east to Puerto Berrio, whence river steamers take it down the Magdalena to Barranquilla, beyond which there is a rail haul of 17½ miles by the Barranquilla Ry. to the Atlantic port of Porto Colombia. This general situation is explained by the sketch map in Fig. 2. It will be noted that there is a gap in the Antioquia Ry., and until that part of the line is built all freight has to be transferred over a mountain spur by trucks.

The American Contract—In 1924, a contract for the 25-mile extension was secured by Charles S. Whitaker, vice-president of Winston Brothers Co., contractors, St. Paul, Minn. At that time the line had been located to Kilo. 72 (from Medellin) and the Colombian authorities requested the company to engage five American engineers to complete the location and to supervise the construction. The departmental company also took from the United States experienced foremen for grading, concrete and tunnel work, accountants, tractor and steam-shovel operators, machine-drill sharpeners and mechanics. The remainder of the engineering staff and the construction forces were Colombians. All plans and work are subject to the approval of Dr. German Uribe, chief engineer for the departmental government. Much of the following description is from information furnished by E. L. Dorsett, of the Winston company.

Difficulties of Location—Railway location in the Andes presents exceptional difficulties. Even with the maximum metric curvature of 14 deg. 20 min. (with 20-meter chords, equivalent to curves of 21 deg. 56 min. by American measurement) and with the maximum compensated grade of 3 per cent it is impossible to avoid heavy earthwork. In places, this amounts to 200,000 cu.yd. per mile (97,000 cubic meters per kilometer), as the slope of the mountain sides is so steep that it is necessary to locate the line mainly in excavation. With a fill only a few feet deep on the center line, the lower slope will often run out several hundred feet. There is not only the difficulty of making the fill but also the danger of slides caused by the excessive tropical rainfall, so that heavy fills are impracti-

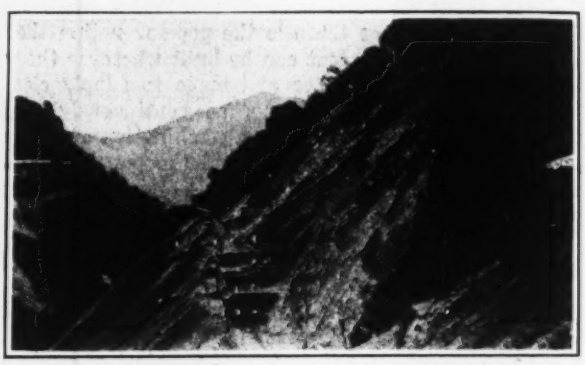


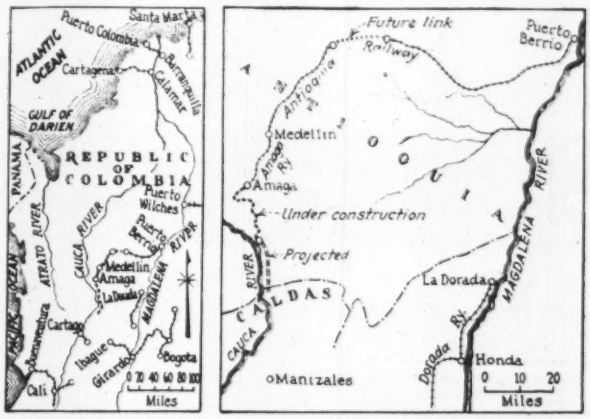
FIG. 1—TYPICAL GRADING ON THE AMAGA RY.

cable and the bulk of the excavation is wasted at the ends or over the sides of cut.

Transporting Construction Material—At first all material was transported from the end of steel either on the backs of native peon laborers, or by pack mules, over trails built above the upper slopes of the cuts. Such trails would be rebuilt several times owing to slides caused by rainfall. After taking over the work, the Winston company built from the end of steel to Kilo. 76 a road on a 5 per cent grade and wide enough for crawler tractors and trailers. This is not more than ¾-mile from the line at any point, the materials being then transported to the work by laborers or mules. From Kilo. 76 to the end of the line at Kilo. 98, through the Lower Sinifina canyon, the cost of a road of such width would be prohibitive, and it is planned to lay a narrow-gage track above the upper slopes of the cuts. This construction line will be operated by gasoline locomotives.

Much of the lumber for camps came by rail over the Antioquia Ry., and then to the head of the Amaga Ry. Thence it was taken to its destination by mules, a few pieces being lashed to the pack saddle on each side, leaving the rear ends to trail on the ground. At one point the Antioquia Ry. is interrupted by a spur through which a 2½-mile tunnel is to be driven, but at present all freight and other material has to be unloaded, hauled over the summit in trucks and again loaded into cars, as noted above. A large portion of the timber and lumber is whip-sawed, as in Fig. 4, which adds to the cost.

Camps and Sanitation—Camps for the supervising forces are built usually of lumber, with galvanized-iron or clay tile roofing. The former is the more expensive but is used if the material has to be packed a long distance. For short distances it was cheaper to use native tile, which is of good quality and makes a much cooler building. It was not easy to find suitable sites for camps, and where the topography was such as to provide a site without grading there was usually no water supply. As iron pipe for delivering water to the camps would be very expensive, bamboo poles were used, about 5 in. in diameter, with the cores punched out. All water had to be boiled to guard against dysentery, and few men contracted this disease. There was some malaria, but the cases were kept down to about 3 per cent of the total number of men, which is about 3,000. The medical department, supervised by



GENERAL MAP OF DISTRICT MAP OF RAILWAY NOW BUILDING

FIG. 2—THE AMAGA RAILWAY AND CONNECTIONS, COLOMBIA, SOUTH AMERICA

Colombian doctors, was in charge of Dr. Emiliano M. Henao, chief engineer for the department.

Grading Plant—When the American company took charge, construction between Kilos. 58 and 65½ was being carried on by the railway on a day-labor basis, with approximately 1,800 men. About 40 per cent of the excavation on that section had been moved; most of this consisted of earth. With the exception of a revolving steam-shovel (then being assembled), the grading equipment consisted of wheelbarrows, Decauville steel cars of 9 cu.ft. capacity, and small tools. The plant ordered by the company included another revolving steam-shovel, 1½ and 4-yd. dump cars, portable gasoline air compressors, crawler tractors and trailers, 7-ton gasoline locomotives, machine drills, small tools, explosives and supplies. Equipment such as is used on heavy work in the United States could not be utilized on this line, owing to transportation difficulties. Steam-shovels could be used only on certain sections, between Kilos. 58 and 74, owing to the difficulty of moving them.

Heavy Earth Cuts—Milling is employed for many of the earth cuts, with excellent results. This method is very suitable here, as the cuts are 50 to 100 ft. deep on the center line, with the upper slopes often running to a height of 165 to 250 ft. Drifts 6 x 6 ft. are driven on the center line. At first only the small Decauville cars were used, but the quantities are so large that it was planned to use the 1½-yd. cars. As the bulk of the material is wasted, the loaded haul is down grade, so that a 7-ton gasoline locomotive can handle five cars on the 3 per cent grade without difficulty. Timber for shoring the drifts is obtained at not more than a mile distant. As the standing timber is scattered, no mule trails were built but the timber is brought in by peons.

The material often changes radically in a very short distance, varying between sand, sandy clay, red clay (often good brick and tile clay) and blue clay. Many of the cuts were taken out with wheelbarrows. When this method is used in deep cuts and slides are feared, the cut is opened at the upper slope and taken out in about 16-ft. lifts, the material being cast or wheeled over the slope. The natural slope of the mountain side is so steep that most of the material slides below the lower slope of the cut. After the cut has been excavated to a level with the lower slope, channels are excavated from the natural slope into the side of the cut. By doing this the cut can be worked in as many places as desired.

Several earth cuts are being made by the hydraulic method, where a 200 ft. head is available, using 5-in. spiral pipe with a 2-in. giant. The main difficulty is in building a tight flume out of whipsawed lumber, to carry the water from the stream to a point above the cut. As the material is wasted, this method is both rapid and inexpensive.

A clay and rock cut being excavated in the Upper Sinifina canyon is shown in Fig. 1, and it will be noted that the cut is being taken out in successive benches. At the left is the camp; a bad slide has occurred on the point just beyond the camp. Sidehill benching for a sand and clay cut is shown in Fig. 3, with the grade line below and pack trail above. Both of these views show day-labor work by the railroad, before the contract was closed with the Winston Brothers Co.

Ditches and Drainage—Surface ditches are excavated above the upper slopes to intercept surface drainage. Where the mountain side is steep and there is danger of slides, such ditches are placed between 50 to 65 ft. from the slope. Where they have a rather heavy grade, the bottom is laid with 12-in. to 18-in. split clay tile to prevent scouring. The water is led either to small streams or to the ends of cuts into track boxes of stone masonry or corrugated pipe. After passing under the track, the water has to be carried in either a masonry-lined or tile-lined ditch to a safe distance from the grade. To prevent scouring, it is necessary to line all roadbed ditches in earth cuts with split or half tile.

On account of the torrential tropical rains and the quick runoff, the drainage problem is serious. It was found that although there is only a small railroad mileage, the Colombian engineers have made an exhaustive study of this problem, and that it was wise to heed their advice. In many cuts and embankments there was trouble with slides caused by drainage water running on top of strata of clay or soapstone, 10 to 13 ft. below the surface. Here again the Colombian engineer shows his knowledge of drainage by building blind stone drains or (where the seepage is considerable) open stone drains, the bottom of the drain being placed one foot below the top of the clay to intercept the water. At intervals the drains are run beneath the roadbed or the water is turned into a culvert.

In excavating the trenches for drains, 2- to 3-in. bamboo poles are used for sheeting, being worked down as the trench is deepened. Stone for the drains is picked up or blasted from boulders on the hillsides, and either

carried by peons or packed by mules, sometimes for nearly a mile. Where the distance is too great and the bamboo sheeting will hold until the grade is completed, the stone is placed later, being hauled along the grade with a tractor and trailer.

Rock Cuts—Little progress had been made in rock excavation by the day-labor forces, owing to lack of proper equipment. Single jacking was the usual method of drilling, the holes being seldom more than 3 to 4 ft. in depth, with charges of three or four sticks of 40 to 60 per cent explosive. Where material is not required for embankments, cuts are now opened by coyote holes, moving 50 to 60 per cent of the material over the slope without handling, while the remainder is so shaken as to require little additional explosive. For side-hill cuts with little or no toe, churn-drill holes are put down and the rock is slabbed off in benches. Churn drilling is also used in the faces of cuts.

Portable gasoline-driven compressors for the drills are made in units small enough to be carried along the trail by peons. Air is piped down to the cuts and distributed to the drills with 50-ft. sections of hose. Jack-hammers are used in driving the coyote holes and powder pockets. Black powder is used to a small extent, but in many cases there is too much moisture for this, and most of the blasting is done with 40 and 60 per cent dynamite.

With the exception of trap rock in the Lower Sinifina canyon, Kilos. 78 to 98, the formation is mostly granite. Very little of it is of good quality and there is difficulty in obtaining even a sufficient quantity for retaining walls to hold the slopes of fills and for pedestals and abutments for the bridges. A great deal of the granite is of a disintegrated nature and loosens and crumbles when exposed to the air. Owing to the difficulty of transporting heavy plant, the greater portion of the grading will be done by hand.

Bridges and Culverts—In the interior of Colombia, bridges mean to the engineer such large expenditures that they are avoided wherever possible. The difficulties of transportation and the lack of erecting machinery and of experienced bridge men also increase the cost. Pile and timber bridges are little used, on account of the scarcity of proper timber. It is difficult even to obtain timber large enough for construction trestles without going to great expense.

On the 20 miles located and under construction, there are eight structures aggregating about 750 tons of steel. Four of these are on metric curves of 14 deg. 20 min. The first and highest, over the Upper Sinifina canyon, is 124½ ft. high and 295 ft. in length. Owing to the heavy curvature, the weight of steel is approximately 40 per cent more than if it were on a tangent. These structures were designed and fabricated in the United States.

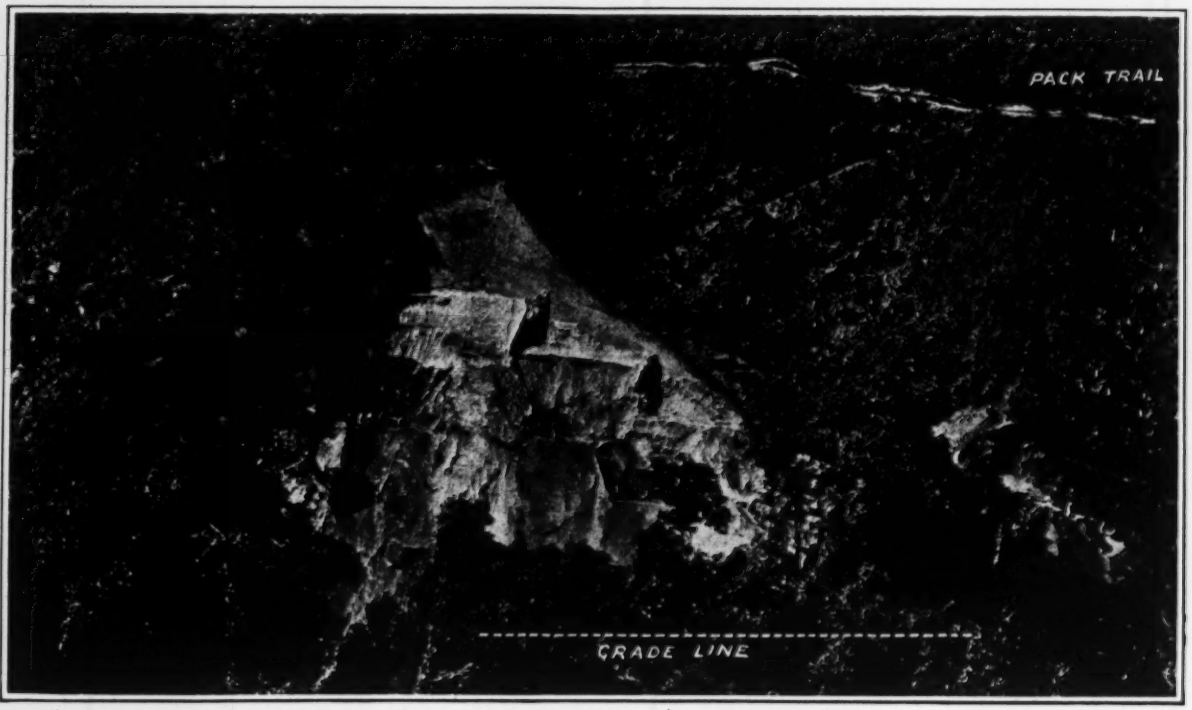


FIG. 3—BENCHING A SIDE-HILL CUT ON THE AMAGA RY.

Stone masonry will be used in all column pedestals, piers and abutments. As cement costs $11 per barrel at the end of steel, with the added cost of transportation to the site, concrete is used as little as possible. Where suitable stone is at hand, high class masonry can be built for about $7.65 to $9.17 per cubic yard. The Colombian mason does good work, but there is difficulty in obtaining enough of these men. All masonry will be on solid rock at a depth of not more than 10 ft., except that the second crossing of the Sinifina may be built on gravel.

Sand for the mortar will be transported by crawler tractors and trailers to within a short distance from the bridge, and then packed by mule-back. It is planned to have all masonry completed before track is laid to the bridges, so that the erection of steel will be the only delay to tracklaying after the tunnels and the grading are completed.

Culverts—The culvert problem, like drainage, is

troublesome. Most of the culverts on the existing railroads are of masonry, but owing to the scarcity of masons it was decided to try some concrete boxes in order to speed up the work and not delay the grading. As much of the lumber is whipsawed and not seasoned, it is difficult to construct tight forms, so that corrugated iron sheets are used. Wedges are used in place of nails as far as possible, so as to reduce damage to the forms in taking them down.

When concrete culverts were started, there was no

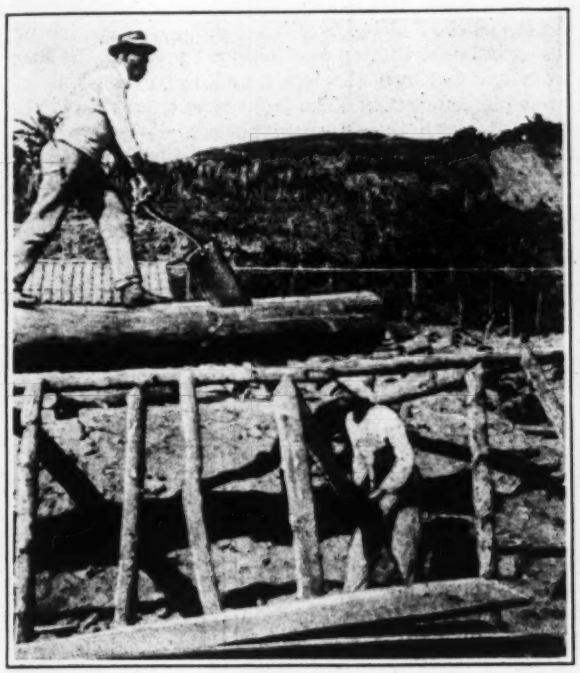


FIG. 4—SAWING TUNNEL TIMBER

rock crusher, and as gravel was not to be had, all coarse aggregate had to be broken by hand. With labor at $1 per day, rock could be broken for $2.30 per cubic yard. It had then to be transported by pack mule to the culvert site. Concrete is made by hand or in a mixer of 3½ cu.ft. capacity. In many of the openings the grade of the stream is as high as 35 per cent, so that masonry culverts must be built in steps to prevent their sliding. This necessitates a much larger opening.

Unless the sides of the creek are in rock, the culvert has to be laid in the creek bottom, or the water leaving the outlet would scour and cut back under the roadbed. As most of the mountain sides are cultivated, it is also necessary to confine the water to its regular channel to prevent damage to adjoining land. For some of the smaller openings 24-in. corrugated pipe is used. This comes knocked down, and can be easily transported by pack mule, but there are few openings where even two lines of 24-in. pipe will give sufficient capacity. Steel forms were ordered for concrete arches of 4, 5 and 6 ft. diameter. In a few of the larger openings through rock, it is planned to drive small tunnels in the side hill under the embankment. If these tunnels require concrete lining, the steel arch forms will be used.

When the contractors took over the work, the Colombian engineers were making 30-in. reinforced-concrete pipe in 4-ft. lengths and 4-in. thick. The sectional steel forms, aggregate and cement are packed to the culvert site and the pipe is made near the culvert. Sheeting for culvert foundations is of bamboo poles, and it is said to be surprising how well 2-in. bamboo poles withstand the pressure. Some of the excavations are from 6 to 10 ft. deep.

Tunnels—In tunneling, the consideration is the cost of timbering and concrete lining rather than the cost of excavation, so that some cuts have been made where tunnels would have been built under conditions obtaining in the United States. Furthermore, most of the tunnels are located on the maximum curves, adding greatly to all quantities. The heavy curvature does not increase the cost per cubic yard to any extent, but increases the difficulty and cost of timbering and concreting. Most of the timbering is of hardwood, equivalent to American oak. An expert tunnel man was imported from the States, but he found no experienced tunnel men to assist him, as so few tunnels have been built in Colombia.

Between Kilos. 58 and 80 there will be six tunnels, with a total length of about 1,800 ft., the longest being only 460 ft. The first two will be in disintegrated granite, some of which is soft enough to be bored with coal augers. Here, timber lining is required and concrete lining will be placed later. The next three tunnels, in a harder granite, may require concrete only for the portals and entrance lining, while the sixth tunnel, being in the trap rock of the Lower Sinifina canyon, is not expected to require lining. The timbering is of 10 x 10-in. timbers, with 3-in. lagging of various widths and packing of any small round timber that is obtainable locally. Mud sills are used in disintegrated rock, while in solid rock the plumb posts are seated on wedges. These posts, spaced 4 ft. c. to c., carry wall plates and five-segment arches.

Machine drilling will be done with the aid of the portable gasoline air-compressors; 1½-yd. side dump cars will handle the muck. Lining the tunnels with concrete will be left until after the track is laid to the Cauca River, where good sand is available and will be hauled to the sites by rail. Trap rock from excavations in the Lower Sinifina canyon will provide the coarse aggregate. Providing lumber for forms will be a difficulty, and its high cost will be increased by the transportation and framing. It is stated that sectional steel forms cannot be used as the tunnels are not on tangent but on curves of different degrees; otherwise, such forms would reduce the cost of concreting.

Pay-Day Methods—The men are paid twice a month, and during working hours, the paymaster riding from one crew to another. First come the paymaster and inspector on their mules; then comes a peon with the money chest strapped on his back. Behind him come two railway policemen with loaded rifles; then a monk to collect for the church. Next come a number of peddlers with their bundles, and behind them are the beggars and the money lenders. When they come to the crew that is to be paid off, the captain calls the men. The paymaster and the inspector sit down and open the money-chest; the policemen stand by with rifles ready. One peon stands at the paymaster's elbow with a bowl of water for him to dip his counting fingers in. The monk takes up his position and the peddlers spread their wares in a ring around the men. The peon gets his money, gives the monk and the money lender what he chooses, and then goes to the peddlers. It takes about an hour to pay off a crew in this way.

Emergency Repairs to Damaged Highway Bridge

Main Post Bent and Cracked by Colliding Street Car—Damaged Section Replaced by New Section

By R. H. Helick
Bridge Maintenance Engineer, Allegheny County Department of Public Works, Pittsburgh, Pa.

On the night of June 29, the rear truck of a street car crossing the 505-ft. truss span of the highway bridge over the Monongahela River at Rankin, Pa., near Pittsburgh, was derailed, and after running about 100 ft. swung the front end of the car around sufficiently to strike the fifth post of the truss. The lower part of the post was badly bent and the flanges of the channels forming it were cracked. The length of the post, center to center of pin, was reduced 1⅜ in. from its original length of 56 ft. 1⅜ in.

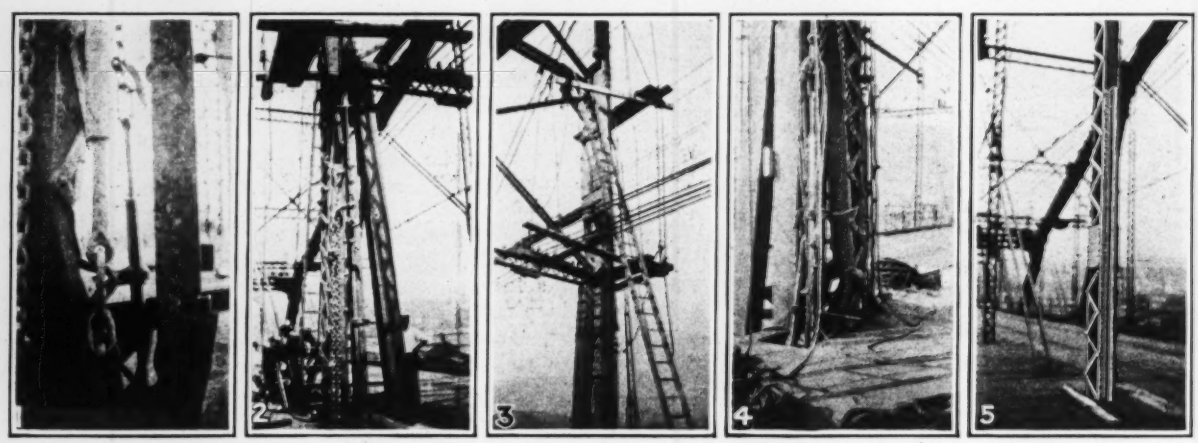
The span affected is a modified Petit truss with subdivided panels, is floored with plank, and carries two street-car tracks. The damaged post is made up of two 8-in. channels at 13.75 lb. per ft. laced with 2½x⅜-in. bars. The accident was not reported until the following day, and in the meantime 30-ton cars were using both tracks of the bridge. Engineers of the Department of Public Works found that as each car passed, the damaged post bent appreciably and the cracks in the flanges opened up slightly.

Pending permanent repair the bridge was placed out of service for about four hours, while a 122-lb. street-car rail was wedged between the floorbeam and a strut one-third of the way up the post. A 10x10-in. timber was placed in addition to the rail, and another timber was wedged between the strut at the one-third point and another at the two-thirds point of the post. Pulling jacks and chains were also placed to keep compression in the temporary members, as may be seen in Figs. 1 and 2. As soon as this temporary work was placed, traffic was resumed in a single line on the uninjured side of the bridge. It was necessary to install temporary crossovers to take care of the street cars, and watchmen were assigned to handle the traffic.

The next morning, work on permanent repairs was started. It was necessary first to replace the emergency timbering with posts which would allow of jacking and which would have better bearing than the timbers installed at first. The latter were bearing on the edges of gusset plates connecting the struts to the post, and there were not enough rivets in the connections to take care of the load. To relieve them, brackets were bolted to the post above each strut, thus again applying the load to two points in the length of the post for greater security. Two 10x10-in. posts with house-raising jacks were placed between the upper and lower brackets, and two others between the lower bracket and the top of the floorbeam (Figs. 3 and 4). Blocking was placed between the top and bottom flanges of the floorbeam and between the latter and the eyebars at the lower pin connection. The jacks thus operated between the post above the damaged place and the lower pin connection. One of the temporary 10x10-in. timbers was replaced for added safety.

After all was made secure and the pulling jacks had been readjusted, one of the channels of the damaged post was cut away for a distance of 7½ ft. and two angles 5x3x⅜ in., back to back, long legs outstanding, were bolted to the outside of the channel web, above and below the cut, as sketched in the drawing, Fig. 6. Before they were bolted up, an attempt was made to recover some of the 1⅜ in. in length of post, which had been lost, and ¾ in. was actually added by working the lower jacks. This was deemed sufficient, as the load was evidently being taken by the timbering.

After the first angle was bolted up, the remainder



FIGS. 1 TO 5—REPAIRING BRIDGE POST DAMAGED BY TROLLEY COLLISION
Fig. 1—Near view of damaged post. Fig. 2—Temporary timbering. Fig. 3—Second timbering placed between brackets. Fig. 4—Ready for cutting out damaged part of steel member. Fig. 5—Completed repair.

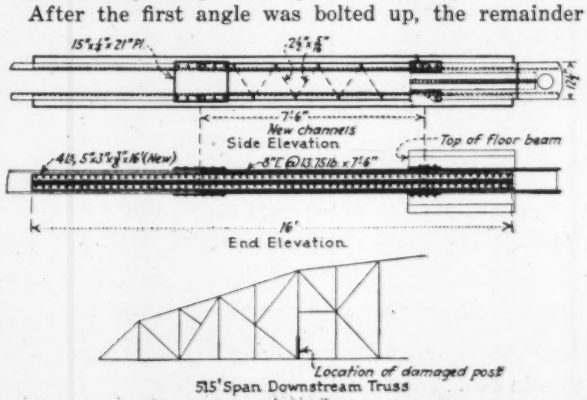


FIG. 6—POST AS REPAIRED

of the damaged post was cut away. At this stage, new sections of channels were placed in the gap and bolted to the first angles placed, as well as to the second pair.

The holes in the splicing angles were placed 3 in. on centers, but only every other hole was bolted. This, with the temporary work, made the post sufficiently strong to take full loading, and unrestricted traffic was restored at 9:50 p.m., July 3. The work had been pushed to get the bridge in condition to take the heavy travel expected on the Fourth of July, and when this was done, overtime was eliminated for the rest of the work.

All bolts, except those inaccessible, were replaced by rivets, all holes being filled. Lacing bars were replaced, and where the post had been drilled for the brackets, plates were riveted on to replace the steel lost in the holes. The job was completed July 8.

The work was done by John Eichleay Jr. Co., under the supervision of engineers of the Department of Public Works of Allegheny County, Bureau of Bridges. Its cost was $1,450, of which a large part was due to overtime.

Steel Frame Brick Residence Supported on Steel Bents

A RESIDENCE distinctive in conception and location and unique in design is being erected at the top of the 200-ft. bank of the Hudson River at 187th St. and Riverside Drive, New York City. The location and basic design result from specific requirements desired by the owner, a devotee to outdoor life and fresh air. In order to afford the maximum exposure to the elements, and incidentally a magnificent view up and down the Hudson, the house overhangs the top of the cliff-like terrain, and is supported on a structural steel framework as shown in the illustration and drawing.

The building proper is of the conventional office building design of structural steel frame and brick walls. Since the New York building code does not cover specifications for steel frame dwellings, a special permit was necessary before construction could proceed. Permission was obtained to use an 8-in. wall instead of the 12-in. as specified for office buildings; this construction resulted in only a 4-in. covering for the columns instead of the 8-in. as specified in the building code. In reality the wall is 10-in. thick since a 2-in. air space is used between the interior and exterior walls. The walls are tied together with metal ties, this represents another departure from code requirements, which state that no metal ties are to be used.

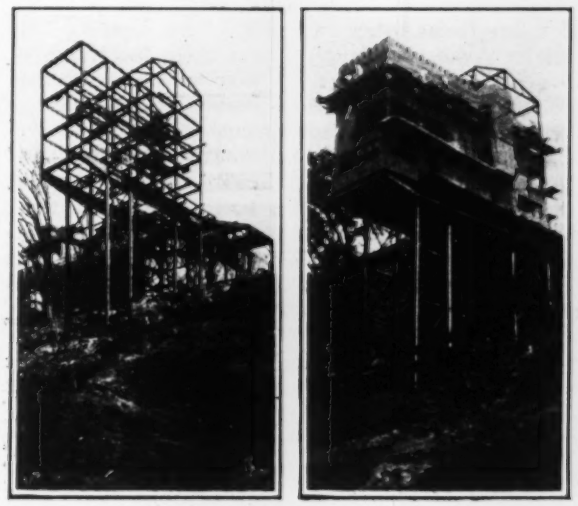


FIG. 1—TWO STAGES IN THE ERECTION OF A TOWER RESIDENCE

The building is approximately 17½ ft. by 54 ft., and a surface approximately 33 ft. high is subjected to wind pressure. The wind pressure was figured at 30 lb. per square foot, which gave 990 lb. per lineal foot of building. Adding to this the wind pressure against the substructure gave a considerable overturning moment perpendicular to the narrow dimension of the building. This condition represented another obstacle that had to be safely provided for before a building permit was granted. Three 1¼-in. deformed anchor bolts are used at each column base. These are grouted 3 or 4 ft. into the solid rock foundation.

The steel bents of the substructure are tied together with 36-in. plate girders upon which rests the framework of the house. These girders are cantilevered about 15 ft. at the river end on account of foundation conditions for the footing of the outside bent.

The residence will consist of a "basement" used for garage and workshop, a first and second story and a

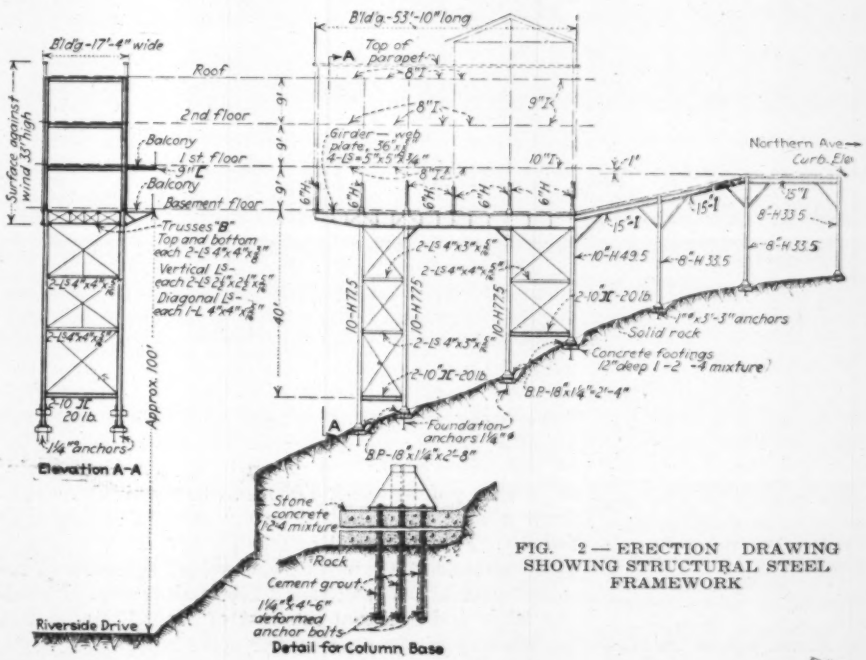


FIG. 2—ERECTION DRAWING SHOWING STRUCTURAL STEEL FRAMEWORK

parapet-walled roof partly covered with a tile roof shelter house. The garage is reached by a ramp from the street level of Northern Ave. No plaster will be used in the building, varied colored brick giving the desired architectural effect. The floors and roof are 4-in. cinder concrete slabs reinforced with wire mesh. The ceilings are to be left rough and the floors covered with different colored tile and terrazzo. Interior stairways are of steel and architectural ironwork, as are the balconies surrounding the first floor and each of the windows. The house is fireproof in every detail the superstructure frame being incased in cinder concrete. All interior doors are omitted except those necessarily of fireproof construction. Each room is heated with an individual gas radiator, thus eliminating the necessity for furnace room in the basement.

All electric wiring is carried in exposed conduits and the gas and water piping is bracketed from the walls. The water and sewer piping enters the house from Northern Ave. above the basement floor; thus this piping is exposed to the weather for a short distance just before it enters the house, and some special construction will be necessary to prevent it from freezing.

Franklin D. Pagan and Harold D. Vernam of New York City were the architects for the structure. The Werner Contracting Corp. of New York City is doing the actual building work.

Sanitary Control in the Development of Ground Water Supplies

THE following Code of Principles was formulated by a committee of the Conference of State Sanitary Engineers and adopted at the Louisville conference on April 25, 1925:

General—1. *Sources* of ground water supplies should be located so as to prevent their contamination by surface drainage, flooding at times of high water, and by pollution resulting from proximity to sewers, privy vaults, cesspools, sewage wells, other leaching devices for sewage, streams, abandoned uncapped wells, sinkholes, etc.

2. *Suction* and *gravity piping* should be constructed with watertight material and joints, preferably cast iron and never sewer pipe. These lines should be located at a safe distance from sources of pollution and tested frequently to determine their tightness.

3. *Collecting* or *storage reservoirs* and *suction wells* should be carefully located, constructed waterproof, and covered. All manholes, vents and overflow openings should be properly protected from dust, small animals, and willful pollution.

4. All *connections* between a safe source of supply and a polluted water supply should be effectively eliminated.

Wells—5. Well supplies should be protected from *contamination at the surface* by the following safeguards:

(a) A *well pit* or *subground-level pump room* should be avoided wherever practicable, and the pumps installed on a pump room floor located above the surrounding ground level.

(b) If conditions necessitate the installation of a well pit or sub-ground-level pump room, the floor and walls should be made watertight, and a *drain* to an open outlet (under no condition connected to a sewer), or a *sump* and *automatic ejector* should be provided to remove the waste water.

(c) The *outside casing* or *curbing* of wells should be extended above the level of the ground or floor of the pump room or pit, and a watertight connection installed to close the annular opening between the well casing and pump column or drop pipe. *Dug wells* should be provided with a watertight cover, and the pump pipe, manhole and other openings should be properly protected so as to prevent waste water or other contaminating material from entering the well. Pumping equipment should not be installed in the well in a manner requiring entrance of an attendant.

(d) On *air-lift pumping* systems, the *air inlet* should be properly located and protected to minimize the entrance of dust and other contaminating material.

6. *Well supplies* should be *protected* from *underground contamination* by the following safeguards:

(a) A watertight *outside casing* or *curbing* should be installed, extending deep enough to prevent contaminated surface or shallow ground water or other pollution from entering the well through strata such as coarse gravel and limestone containing fissures, openings and solution channels. The bottom of the casing or curbing should be effectively sealed into a solid formation, and thoroughly tested to make certain that contaminated water on the outside of the casing cannot enter the well.

(b) *Wells* installed with a *gravel wall* should be protected by forcing into the space between the outside casing and well hole sufficient *puddled clay* to give a protective clay depth of at least 12 ft. below the ground surface or any strata carrying contaminated water.

(c) Where the water is known or suspected of being *corrosive*, a metal well casing should be protected by providing a *shell* of *cement grout* at least 2 in. thick around it. An alternate method, suitable in some instances, is the use of a casing consisting of cast-iron or best grade wrought-iron pipe with a double coating of bituminous material.

(d) A *separate suction* or *discharge pipe* should be installed inside a well casing in all instances, whether the well is to be pumped by suction air lift or be used as a deep well pump.

7. *Continuous purification* or *treatment* should be provided to suit the circumstances, where wells are not provided with the required sanitary safeguards, as outlined above, or where bacteriological or chemical tests, or other conditions indicate that contamination is reaching the waterbearing strata.

Springs—8. *Springs* should be protected from *surface contamination* by a waterproof concrete curbing and top. Springs which show analytical or field evidence of *underground contamination* with surface water or sewage should be effectively purified or treated.

Mine Water—9. Water from mines subject to contamination or pollution requires adequate purification or treatment to make a safe supply. Special water supply drifts located in mines should be protected from flooding and drainage from working shafts and drifts.

Infiltration Galleries—10. Water from *infiltration galleries* should receive suitable purification or treatment unless located and operated in such way that satisfactory bacterial removal is secured.

Plastic Filling for Spike Holes

Plugging spike holes in ties with an asphaltic composition instead of the usual wood plug has been introduced on the Western Australian Government Railways by H. A. Cresswell, chief engineer, the purpose being to obtain some material which would grip and hold the new spike. The composition is prepared at the shops and distributed in cake form to the section gangs, which are equipped with portable heaters. Where a spike is removed on account of enlargement or decay at the spike hole, the hole is cleaned out and then filled with the hot composition, tamped in place. In a few minutes, while the filling is still plastic, the cut or screw spike is driven, and after about 15 minutes the material has become quite hard. If the spike is lifted by the action of the rail it can be driven down again. In tests, a pull of about 4,000 lb. was required to withdraw a ⅝-in. cut spike. The composition is given as follows: 1 quart tar, 4 ounces pitch, 1 lb. bitumen, ½ pint kerosene, 2 lb. hardwood sawdust screened to remove material that will pass a 100-mesh screen. Including labor and material the cost of reconditioning ties in this way is given as 4c. per spike hole.

Engineering in the Small City

A series of notes from the field on the Problems and Practices of the Municipal Engineer in the Cities Below 100,000

The Editor Visits the City Engineer

Snapshots of Our Representative Small Cities

RAILROAD YARDS, POCATELLO, IDAHO

Pocatello, Idaho

POCATELLO IS PRIMARILY A RAILROAD CENTER located on the Portneuf River above its junction with the Snake. It has grown slowly but steadily since its establishment in 1882 and in recent years, as automobile touring has become popular, has attained importance as a city on the main highway route to Yellowstone National Park. In the valley directly north of the city are several thousand acres of fertile irrigated land which contribute directly to the city's prosperity. Besides extensive shops and yards of the Oregon Short Line R.R., Pocatello has a wholesale district that supplies smaller communities within a radius of 50 to 100 miles, a creamery, a cheese factory and an ice plant that services refrigerator cars. Pop. 1920, 15,000.

"RAILROAD towns," that is, division points where the payroll in yards and shops is the largest material contribution to the city's business, have certain well-known characteristics, namely, (1) railroad expenditures are an accurate barometer of local prosperity, (2) an important part of the population though not actually "transient" has a rather uncertain period of residency which does not make for a high degree of interest in public affairs, and (3) labor for city improvement can usually be had at reasonable rates from among the "extras" that wait and watch for railroad jobs. All of these things have a bearing upon the problems of the city engineer in Pocatello, Idaho, because Pocatello is primarily a railroad town. In its shops and yards railroad equipment is serviced and trains are made up for important lines that run north, east, west and south.

Pocatello really dates from the construction of the railroad (then the Utah and Northern) in 1882, although the townsite was not actually laid out until 1890. It is located in a narrow valley between barren hills, boasts practically no manufacturing or mining interests and like many other Western "centers" derives considerable support from smaller towns and farming districts largely because there are few other cities of importance within a hundred miles or so.

The city engineer, J. H. Giles, is responsible to a city council of five consisting of the mayor and four council members, elected at large, in which is vested the control of all municipal affairs. This council does very little work on the committee plan, handling practically all business in regular session. Every two years two of the four councilmen are elected for a 4-year term. The present plan is the result of revision of an earlier charter under which the council consisted of ten members and was found too unwieldly for efficiency. The city engineer also holds the title of street commissioner for convenience in handling paving contracts and has considerable latitude in this respect subject always to council control.

The railroad main lines and yards pass directly through the center of Pocatello. This division of the city by railroad property several hundred feet wide has given rise to a grade separation problem and also has a tendency to split the city into factions on some municipal questions, particularly bond issues that are likely to be of considerable importance in the work of the city engineer. The main business and hotel district and a residential section are on the west side of the yards while on the east is the chief residential section, the wholesale district and the Idaho Technical Institute, a vocational school with an enrollment upward of one thousand.

Thus far it has been feasible to get only three street crossings across the railroad yards. One of these is a grade crossing; a second is an overhead bridge and the third is a subway. The railroad has paid the entire cost of all these crossings, which is considered only fair in view of the fact that under the Idaho law railroad taxes are prorated on *main line* mileage and hence the city is allotted only the quota called for by the length of main line within city boundaries. The next step in the crossing problem will likely be the conversion of the grade crossing into a subway. At this point the yard is 200 ft. wide which, with 8 per cent approaches, will call for a 600-ft. subway.

Rehabilitating the Water System—The water supply was provided by the Pocatello Water Co. until 1916 when the city bought out the private company. Then the city engineering department realized what must be expected in the line of reconstruction after such a transfer; of the 16 miles of water mains of 4 in. and over then in service, many were too small for the demand upon them and as a whole the system was in a very much run-down condition. The growth of business districts on both sides of the railroad yards had resulted in fire-protection requirements such as would ordinarily be required by two cities and hence called for special provisions. Immediate rehabilitation of the distribution system was begun under the city engineer's direction and now there is a total of 37 miles of pipe of 4 in. or over and most of the important mains have been relaid in larger sizes.

Three sources of water supply are used, the most distant being Mink Creek whence the supply is brought through a 10-mile, 14-in. wood-stave line. The amount of water available and, for the present, the size of the lines bringing it in are adequate, but more storage is needed. When the question of how to provide additional storage came up there was no quibble about a reasonable expenditure for special engineering service and E. S. Anderson, a consulting engineer, was called in. He is now preparing plans for one or two new reservoirs to have a total capacity of 100,000,000 gal. which would allow for needed sedimentation. The daily per capita consumption varies from 90 gal. in winter to 167 in summer. About 90 per cent of the system is metered.

Repairs and actual laying and calking of new mains (lead joints exclusively) is done by a small crew of skilled men which the city finds it desirable to keep on

the payroll steadily during the six months of the year when field work is ordinarily done. Men for ditching and other common labor are always available and are employed only as needed.

Because a few B. coli were found in the water early this summer and because campers sometimes use the watershed, chlorine treatment was decided upon for this season, and an automatic chlorinator was put in. This has been satisfactory, so far as the variation of dosage is concerned, but the fact that no automatic closure is provided on the chlorine flow when the power goes off the pressure pump has been a serious drawback. The city has been remarkably free from any deposit of scale in the pipes. Pipe taken up recently which had been in service over 30 years showed clean interiors.

The city also holds a water right of 12 sec.-ft. in the Fort Hall irrigation project whose main ditch flows close to the city. In order to reduce demand on the potable supply, a secondary or low pressure piping system has been installed to serve irrigation needs only. The city lays these low pressure mains in alleys and allows property owners to connect one tap per building lot on a flat seasonal rate of 10c. a front foot.

Although the water supply is part of the city engineer's responsibility there always has been a tendency to regard it is rather as a separate department and for six years successive city engineers have found it advisable to retain as its superintendent C. M. Rainey, the present incumbent. Mr. Rainey, who is half Indian, has been connected with the water system since it was in private ownership.

Street Work—All paving work is done by contract although the city engineer has found it desirable to maintain a crew of four men to replace pavement over utility cuts and to do any maintenance work required. Most of the pavement is asphalt, but concrete gutters are always used and it has become the custom to use concrete in paving alleys. Repairs are said to be almost negligible although some of the paving is 10 or 12 years old. When new paving is to be laid bonds bearing 5 per cent interest are issued against the district to be improved on an assessment basis worked out by the city engineer. The contractor either takes the bonds outright or takes 7 per cent warrants, leaving the bonds for the city to sell.

In the matter of street cleaning a program has been developed and consistently followed in Pocatello that adds much to the attractiveness of the city and visitors are invariably impressed with the cleanliness of the streets. Little more than systematic flushing is involved. The city owns two 600-gal. flushers which are operated for three 8-hr. shifts daily, their function being to wet the streets and flush litter into the gutters. Thus all paved streets are flushed at least once a day and there is also ample time for these same flushers to go over the unpaved outlying districts where a sprinkler attachment is substituted for the flushing nozzle. Schedules are arranged so the flushing in the business district is done in the night-time when few automobiles are on the streets. A crew of four or five street sweepers whose work is principally sweeping gutters is so assigned that the business district is kept clean and every paved street in the city is gone over once in ten days. This program is continued about eight months of the year.

Pocatello is occasionally visited by heavy rainstorms and because of this as well as for the convenience of pedestrians it has been the custom to use covered gutters extensively at street intersections in business and residential districts. The usual construction is a cast-iron plate about 10x30 in. in size spanning from curb to a walkway in the street paving raised on easy curves where the street has been crowned down to gutter level.

General Municipal Developments — An increase in the city's area now looms on the horizon as the logical move in the solution of the problems of a community of about 1,500, just north of the city limits. This community incorporated as a village under the name Alameda, the chief purpose of the move being to make possible the purchase of the private water system. The slogan was "Come to Alameda and save taxes." That was about six years ago. Now taxes in Alameda are higher than in Pocatello and of course the small community can do but little, comparatively, with its limited funds.

Last year, the city bought an entire block in the residential section which is being used as a municipal automobile camp. There was one residence on the block and this is used by the caretaker. The camp is popular with automobile tourists and has been well patronized. Charges are 50c. per car the first night and 25c. thereafter up to the end of the first week. After that the 50c. rate per night again obtains, the idea being not to make it attractive as a continuous place of residence for workers.

Snowfall in Pocatello is not heavy and snow removal by the city is confined to shoveling off sidewalks in the business district and clearing gutters with a blade grader. Street lighting is under contract to the Idaho Power Co.; the street light standards were put up and are maintained by the city while maintenance of the lamps and globes is part of the lighting contract. Sewage disposal is by discharge, without treatment, into the Portneuf River below the city.

Engineering Work

Destructor Heat and Clinker Used in English Paving Work

A CHANGE in location of the electric light and power station of the Borough of Woolwich, administrative county of London, England, having taken away that outlet for utilization of the heat from the refuse destructor erected some 23 years ago, this heat is now used in the preparation of asphalt paving material from the destructor clinker.

The clinker is first passed through a mill, then goes to a magnetic separator which discharges de-metalled clinker into an elevator which delivers the material into a screen placed over storage hoppers with a total capacity of 70 long tons. By proper screen adjustment fine material ranging from ¼ to ½ in., for use in carpeting work, is obtained. Tailings are used for base. The screened clinkers are lifted by an elevator to a rotary heater, supplied with gases from the destructor furnaces, which are said to leave the combustion chambers at 2,400 deg. F. and to enter the heater at 1,400 deg. F. The heated material is lifted by a third elevator to a weighing bin, from which it is automatically discharged into a puddle mixer immediately below the bin, together

Of the Small City

with heated bituminous material. The mixture is conveyed to a point of use on the streets in what are described as "5-ton [long?] distribution vehicles." The drop in temperature en route is from 6 to 8 deg. F. when transported 5 miles, giving, it is said, a possible distribution radius of 40 to 50 miles.

The present market price of "crude clinker in the London area is not less than 7s. 6d. per [long] ton," says the London *Surveyor* of May 15, from which these notes have been abstracted. Other accessories to the Woolwich destructor installation include a "slab-making plant, a brick-making plant and tin-baling equipment." The entire plant and machinery were supplied by the New Destructor Co., Ltd., Pershire, England.

Wave-Actuated Water Hammer Splits 36-In. Sewer Outlet at Paducah, Ky.

INVESTIGATION of breaks in 350 ft. of 36-in. vitrified pipe sewer outlet at Paducah, Ky., indicates that internal rather than external forces caused the damage since the pipes were broken at the top and the top crack opened as much as ¾ in. and remained open. Water hammer induced by wave action during certain flood stages when the pipe was partially submerged is the explanation according to a report rendered to the contractor, E. R. Harding & Co., by A. T. Maltby, consulting engineer, Chicago. His report states:

Starting at the river near Jefferson St. (if extended) a 36-in. cast iron pipe extends on a 5.68 per cent grade, leaving the shore line at a slight angle (upstream) for a distance of 435 ft. at which point it is approximately 50 ft. from the shore at low water, the flow line rising from zero to EL. 23. From this point the sewer continues on a 0.07 per cent grade with vitrified pipe along the levee parallel with the river for a distance of approximately 4,950 ft. to a junction at Husband St., with a 24-in. main which continues along the levee on a 0.1 per cent grade a distance of 2,324 ft. and a 30-in. main running at right angles inland from the aforesaid levee line, up Husband St., on a 0.14 per cent grade for a distance of 4,950 ft.

The lower end of the cast-iron pipe is submerged at low water. There is a manhole at the upper end, and at each street intersection, if extended, or approximately 400 ft. apart, over the balance of the line. The manhole covers are, however, clamped (bolted) down and are *not* ventilated. The clay soil causes the joints to seal up practically airtight. It is strictly a sanitary sewer having no street inlets and no house connections.

The first block following the cast-iron pipe between Broadway and Kentucky Ave., if extended, has only 4 to 5 ft. of cover and the next block, between Kentucky Ave. and Washington St., has 3 to 4 ft. of cover, and the next or third block between Washington and Clark Sts. is through a deeper cut and for two-thirds of the way is covered by a series of marine ways in connection with the local shipyard. The sewer is there protected by a saddle of concrete. The following or fourth block, between Clark and Adams Sts., has 10 to 12 ft. of cover for about one-half the block and about 5 ft. for the last half beyond Langstaff's tramway. There is 4 to 5 ft. of cover over the balance of the line.

Starting with the first manhole following the cast-iron pipe at Broadway the pipe is sound for the first 50 ft., then the pipe is cracked and broken to within approximately 50 ft. of the following manhole at Kentucky Ave. In the next block, Kentucky Ave. to Washington St., there are several cracked pipes. In the next block where covered by the marine ways the pipe is sound, but in the latter half of the next block or fourth from the river, between Clark and Adams Sts., there are ten cracked pipes. From this point to the upper end the pipe was found to be in good condition.

The damage was found to be greatest in the first block, where it was noticed that the cracks were largest at the top, increasing in width as the distance increased until at about midway in the block they were open ½ to ¾ in. decreasing in width again as the next manhole was approached. There are also some small cracks at the spring line and at the upper and lower quarters but all of these are apparently due to the original distortion and rupture of the arch. The damage at the other points mentioned was of similar character, but not so great, apparently decreasing as the distance from the river increased.

It is stated by the city engineer that the character of the soil in which the pipe was laid together with the work done by the contractor in laying the pipe was satisfactory in every way, and that the alignment and grade of the sewer still obtained, the blame being placed upon faulty pipe.

It is found, however, that the pipe had been inspected in such manner and culled to such extent as to call forth a protest from the manufacturers. This rejected pipe was later sold to and accepted by the engineer of a neighboring city. Evidently the inspection of the pipe was of the closest character. The breaks occur where the cut is shallow. Where the cut is deeper and the weight over the pipe greater, no breaks occur.

As the safe permissible load on the pipe is several times greater than that imposed by the earth cover in these shallow cuts it is evident that some force other than the earth cover would be necessary to cause the failure.

Bearing upon this phase of the subject are the following pertinent facts: The Ohio River is joined by the Cumberland River about 5 miles to the east of Paducah and again by the Tennessee River at a point within the city limits, from which the combined waters flow in a northwesterly direction for approximately 12 miles and then in a southwesterly direction to a junction with the Mississippi below Cairo, Ill. Usually during February the flood stage varies for a considerable period between 20 and 40 ft. above zero, sometimes reaching a height of 43 ft. During these flood periods the outlet sewer is entirely submerged throughout its length to a depth of from 10 to 20 ft. This outlet sewer passed through the spring flood period.

It may be that the added weight or pressure of the flood water above the backfill was not transmitted equally to the sides of the sewer pipe owing to the imperviousness of the surrounding clay soil and that the internal pressure, approximately 10 lb. per sq. in., due to the static head of the flood water, while tending to balance the weight on top, was sufficient to force apart the less effectively supported side walls of the pipe and produce the condition as found.

A far greater destructive force is produced, however, by water hammer caused by the ebb and flow of water in a partially submerged (almost full) conduit, so exposed to the action of wind and wave as to bring about a surging effect in the pipe.

It is readily conceivable that the outlet end of this sewer running as it does almost parallel with the direction of the river's flow will, during a flood period, at times come in direct line with the full force of the heaving swell of the storm and reversed currents, and the water go rushing up the back reaches of the sewer. Then as the swell recedes the column of water in the sewer, many tons in weight, also recedes only to be met in its downward return course by another incoming surge, the result of which is a shock, or water hammer, proportionate in force to the volume and velocity of the water at the point affected, the force of which is expended around the internal circumference of the sewer barrel. The weak point, if any, is found and there the break occurs.

The weak points in this particular case are as follows: (1) The trench was excavated 9 in. each side beyond the sides of the pipe thus causing a much greater weight of backfill in the deep cuts than a narrower trench would have caused. (2) Dependence is placed on tamping the disturbed dirt back into the 9-in. space to support the sides of the sewer at the spring line. In such brittle material as burnt clay, a distortion of ¼ in. would cause rupture.

In the case of water hammer under such practice (which was enforced here) the force of the blow is naturally up, through the empty space, against the top, causing the crack at that point and then the expansive pressure due to the inertia of the meeting columns of water would force the sides apart, compressing the comparative loose tamped 9-in. space at the spring line, and leave an open crack at the crown.

Predetermining Concrete Strength On Park Bridges

By Using the Fineness Modulus Method of Abrams Concretes of Required Strengths Were Produced for Bronx Parkway Structures

By W. F. Welsch
Division Engineer, Bronx Parkway Commission, Bronxville, N. Y.

MODERN methods of designing concrete mixtures to produce a concrete of uniform quality, economically, based on researches carried out at the Structural Materials Research Laboratory under the direction of Professor Duff A. Abrams, have been successfully applied in the field in the construction of four reinforced-concrete bridges on the Bronx River Parkway Reservation, No. 28 over the lake and New York Central R.R., at Scarsdale, N. Y., No. 27*A* over the Parkway Drive at Ardsley Road, Scarsdale, N. Y., No. 27*B* over the Bronx River at Popham Road, Scarsdale, N. Y., and No. 50 over the New York Central R.R. at Valhalla, N. Y. A story of the design and architectural treatment of two of these bridges appeared in *Engineering News-Record*, July 2, 1925, p. 16.

The field forces of the engineering department of the Bronx Parkway Commission were supplied with a manual of instructions to enable them to take into account the variation of material in the aggregate to produce a concrete of uniform quality economically. The engineers in charge of the bridges were equipped with portable field offices and the following field apparatus for making the tests to determine the factors for design and control.

Equipment—The equipment supplied was:

1—nest of Standard Tyler Sieves No. 100, 48, 28, 14, 8 and 4 per lin.in., together with circular sieves having openings of ⅜, ¾, 1½ in., respectively, which were used to determine the gradation of coarse and fine aggregate in connection with the fineness modulus.

1—⅝-in. pointed metal rod 21 in. long to be used when preparing a sample of the slump test.

1—machined metal plate 12 in. square to be used as a base plate in preparing concrete cylinder samples.

1—slump test apparatus provided with handles.

1—adjustable steel mold 8 in. inside diameter by 16 in. high.

1—set of standard scales.

Cross-section ruled paper for plotting sieve analysis.

Standards—The standards set for 28-day concrete tests were 3,000 lb. per sq. in. for reinforced concrete placed in the superstructure over the railroad crossings; 2,000 lb. for all other reinforced concrete and 1,500 lb. for concrete where reinforcing steel was not incorporated.

The aggregates used in the concrete consisted of sand and gravel imported from Long Island and various brands of portland cement were used.

The volume of mixed aggregate per bag of cement depended upon the degree of fluidity required which was determined in the field to produce a workable stiff mix to deliver the concrete into the forms and around the steel which the workmen classified as "wet mix."

The accomplishment of producing a workable dry mix concrete which flowed in the spouts in the same manner that the old style wet mix would do was looked upon with favor by the contractors and the loyal co-operation of the contractor's field force was thus obtained.

COMPRESSIVE STRENGTH OF CONCRETE IN BRIDGES AS SHOWN FROM SAMPLES TAKEN DURING COURSE OF CONSTRUCTION

Sample No.	Age In Days	Location	Proportions Cement	Sand	Gravel	Fineness Modulus Sand	Gravel	Ult. Strength as Designed	28 Day Actual Test Lbs. per Sq. Inch	Remarks
1	28	Pipe gallery tops	1	1.98	4.02	2.58	6.52	2000	3030	
2	28	Middle abutment	1	1.98	4.02	2.58	6.52	2000	2200	
3	28	North abutment	1	1.44	7.56	2.58	6.52	1500	1800	
4	28	Pier *B*	1	1.44	7.56	2.58	6.52	1500	1080	Bridge No. 28 over Lake and N. Y. C. R.R. at Scarsdale
5	28	Middle abutment	1	1.98	4.02	2.58	6.52	2000	2200	
6	28	Top—pier 5	1	1.98	4.02	2.58	6.52	2000	3240	
7	28	Top—pier 3	1	1.32	2.68	2.58	6.52	3000	3490	
8	28	Top—pier 3	1	1.98	4.02	2.58	6.52	2000	3200	
9	28	Sidewalk	1	1.32	2.68	2.58	6.52	3000	3680	
10	28	Slab *B*	1	1.32	2.68	2.58	6.52	3000	3950	
11	28	Slab *E*	1	1.32	2.68	2.58	6.52	3000	3040	
1	28	Arch—27*A*	1	1.55	3	2.61	6.57	2000	2160	Bridges Nos. 27A-27B over Parkway Drive at Scarsdale.
2	28	S. E. wing wall	¾	1.55	3	2.61	6.64	3000	3640	
3	28	Crown of arch 27*B*	1	1.55	3	2.61	6.64	3000	3600	
4	28	E. spring line 27*B*	1	1.55	3	2.61	6.64	3000	3140	
1	28	East abutment	1	1.16	2.81	2.64	6.72	3000	3490	
2	28	East abutment	1	1.16	2.81	2.64	6.41	3000	3860	
3	28	East abutment	1	1.43	3.2	2.64	6.41	3000	2300	
4	28	S. W. wing wall	1	3	6	2.64		1500	1690	
5	28	West abutment	1	1.15	3.05	2.64	6.92	3000	3370	
6	28	No. pylon—W. abut.	1	1.04	2.81	2.64	6.61	3000	3980	Bridge No. 50 Over Harlem Division N. Y. C. R.R. at Valhalla. Cracked but did not break under maximum load
7	28	So. pylon—W. abut.	1	1.04	2.81	2.64	6.61	3000	3860	
8	28	Floor slab, W. abut	1	1.04	2.81	2.64	6.61	3000	3380	
9	28	Girder	1	1.04	2.81	2.64	6.61	3000	2840	
10	28	S. girder 3rd pour	1	1.04	2.81	2.64	6.61	3000	3760	
11	28	N. girder 3rd pour	1	1.04	2.81	2.64	6.61	3000	3999	
12	28	Road slab	1	1.04	2.81	2.64	6.61	3000	4010	Did not break under maximum load.
13	28	1st pour E.E. N. gir.	1	1.04	2.81	2.64	6.61	3000	3640	
14	28	1st pour E.E. S. gir	1	1.54	3.18	2.64	6.39	3000	4010	Did not break under maximum load
15	28	2nd pour E.E. N. gir.	1	1.54	3.18	2.64	6.39	3000	3680	
16	28	3rd pour E.E. N. gir.	1	1.54	3.18	2.64	6.39	3000	3430	
17	28	3rd pour E.E. S. gir.	1	1.54	3.18	2.64	6.39	3000	2760	

Experience has shown that fluctuation in the consistency of the concrete was due to the slight variations in the quality of aggregates from batch to batch which was corrected by improving the uniformity of measurement but under no condition was any change made in the water-cement ratio. To increase the workability of the concrete, the qualities of aggregates in the mix were reduced or increased slightly.

Design Method—The following data are supplied to determine the proportions of fine and coarse aggregate after tests have been made for fineness modulus of the fine and coarse aggregate, bulking of the fine aggregate due to moisture contained in fine aggregate, moisture contained in coarse aggregate, in order to design a concrete having an ultimate compressive strength of 1,500, 2,000 or 3,000 lb.

The required fineness modulus of the combined aggregates which permitted the largest quantity of aggregates to produce a workable and economical concrete with a given quantity of water was 5.5 for 1 in. and 6.0 for 2 in. maximum size aggregate.

The size of the coarse aggregate which was incorporated in the concrete was gravel all of which passed a 1 in. circular opening for concrete of a desired strength of 2,000 lb. and 3,000 lb. and the aggregate for 1,500 lb. concrete consisted of all gravel passing a circular opening of 2 in. Sand and gravel were delivered in separate storage piles at the site of the work.

In order to arrive at the proportions for the actual job mix the following approximate proportions per bag of cement were used for the computations:

1,500 lb. concrete...9 cu.ft., sum of fine and coarse before mixing
2,000 lb. concrete...6 cu.ft., sum of fine and coarse before mixing
3,000 lb. concrete...4 cu.ft., sum of fine and coarse before mixing

After the field test for the fineness modulus of the aggregates had been made the above volumes were used to determine the proportion of fine aggregate per volume measured dry to the total unmixed aggregate based on the required fineness modulus and the strength of concrete desired using the following formula:

r = ratio of volume of fine aggregate to sum of separate volumes of fine and coarse aggregates (volume of fine aggregate divided by volume of fine aggregate plus volume of coarse aggregate).
a = fineness modulus of coarse aggregate
b = fineness modulus of fine aggregate
c = required fineness modulus of combined aggregate

Then:

$$r = \frac{a - c}{a - b}$$

The proportion of fine aggregate of volume measured under job conditions is then computed allowing for bulking and the quantity of water to be used per bag of cement deducting for moisture in the aggregate.

During the process of manipulation of the concrete after leaving the mixer, slump tests were made to serve only as a guide for observing stiffness of the mixture.

Results—Referring to the accompanying tabulation, the results of the 28-day test upon the 8x16-in. cylinder samples, it may be noted that the results were closely consistent with the ultimate strength of design and in three cases the concrete did not break under the capacity load of the testing machine.

The concrete test cylinders were made in 8x16-in. molds and were removed from the forms 24 to 48 hours after molding, and stored in wet sand under wet cloths until the day of shipment to the testing laboratory. All of the concrete for test samples was taken from the actual concrete placed during construction and was representative of actual field conditions.

Conclusions—When the method of scientific control is used to obtain concrete of predetermined strength, it is the writer's opinion that care must be exercised and judgment used with particular regard to the quantity of fine aggregate incorporated. Under any condition, it is advisable to increase slightly the quantity of fine aggregate as computed for the job mix when the material is prepared for delivery into the concrete mixers. This slight increase is made to provide for a factor of safety as experience has shown that a slight deficiency of fine aggregate causes a porous concrete to be made, which condition may not always be visible after the forms were stripped but voids may exist inside the mass of concrete. In the particular work described in this article, the quantity of fine material was slightly increased in all cases to provide for this contingency. In the writer's opinion it is very important that others using this method give particular attention to this feature.

Engineering and construction work on the Bronx River Parkway Reservation is under the jurisdiction of the Bronx Parkway Commission, Jay Downer is chief engineer, L. G. Holleran is deputy chief engineer and the writer in direct charge of field engineering and construction.

Irrigation Needs and Possibilities of the Great Plains

AN INVESTIGATION of the irrigation needs and possibilities of the Great Plains has recently been authorized by the Secretary of Agriculture, which promises to be of much interest to those located in the region extending from the Rocky Mountains eastward to the 98th meridian of longitude. Great portions of the Great Plains region have been settled rapidly following years of high precipitation, but the farmers occupying the lands find in a comparatively short time that droughts are so frequent that crop raising is not profitable according to more eastern standards. In consequence many of the settlers fail and move elsewhere only to be followed, after the next series of rainy years, by others equally optimistic, but destined to meet with the same experiences as their predecessors. The situation is further emphasized by the fact that the plains lands generally will apparently not endure continuous planting to grains alone. The humus originally existing in the soil as the result of ages of production of grasses suited to the region and the consequently high character of soil tilth has depreciated in the course of time until after comparatively few years it is found that a given amount of precipitation will not raise the crops that it would have produced 20 years before. The agricultural departments of several of the western states have officially stated this to be the case. The Kansas corn yield has decreased 40 per cent and the wheat yield 17 per cent during a 50-year period. Kansas further reports that many soils of low productive capacity still contain large quantities of plant food, but it is not in available form. The addition of organic matter will aid in liberating this plant food and increase the productivity of the soil. Similar conditions exist in Nebraska and other states. For those portions of the great plains where the annual precipitation is between 15 and 30 in. per annum, the original soil tilth can be restored by the growth of leguminous crops such as the various clovers, alfalfa, etc., but this in turn means a better water supply if the desired results are to be obtained.

For 25 years an office of Irrigation Inquiry, created in the Department of Agriculture and operating as a branch of the Division of Agricultural Engineering, has been studying the irrigation needs and possibilities not only of the more arid regions of the west, but of the other sections, including the Great Plains. Sufficient information is now available so that bulletins of value not only to actual and prospective settlers, but also to engineers and investors, may be compiled and published. This compilation, authorized in July, is under the immediate direction of A. Lincoln Fellows, irrigation engineer, of the Division, reporting to W. W. McLaughlin, acting associate chief of the Division of Agricultural Engineering.

Design and Structure of Double-Deck Street, Chicago

River and South Water Streets, Chicago's Congested Loop-District River Front, Being Transformed Into a Two-Level Concrete Boulevard With a Marginal Dock

THE MARGINAL quadrangle of wide streets laid out long ago by the Chicago Plan Commission to let traffic skirt around instead of go through the downtown business district, or the "Loop," of Chicago is being closed by the construction of a two-deck road on South Water St. This is the north boundary of the quadrangle. On the east is Michigan Ave., widened south of the river, and on the west is Canal St., whose widening is virtually completed. The southern boundary is Roosevelt Road (old 12th St.) under construction and largely wide viaduct over railway yards as most recently described in *"Engineering News-Record,"* Aug. 20, 1925, p. 297. This notable viaduct is surpassed as a street structure only by the double-deck road on South Water St. This will cost some $10,000,000, not including land, and about half is now actively under construction. This and a succeeding article outline

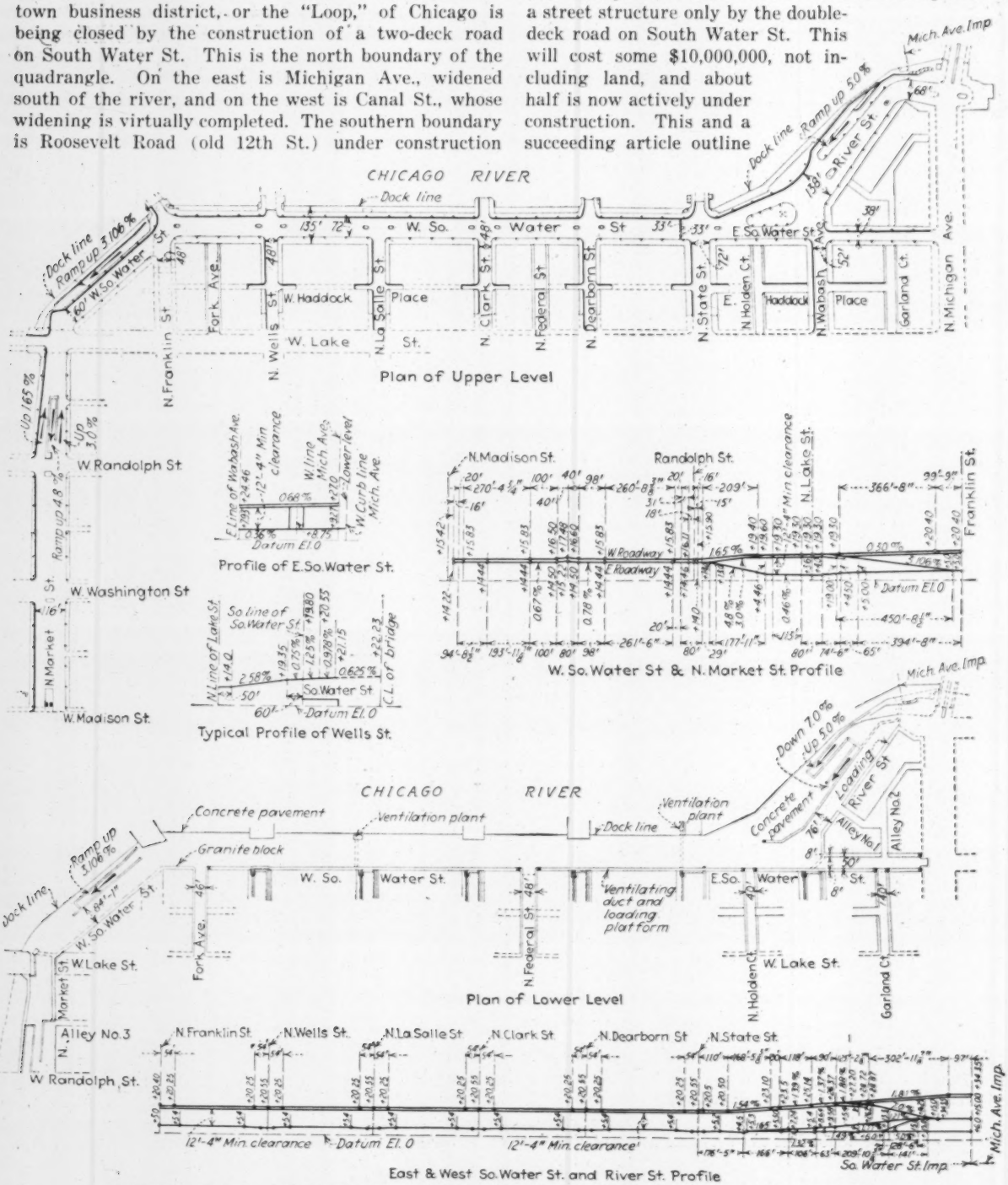


FIG. 1—PLANS AND PROFILES OF TWO-DECK ROADWAY, SOUTH WATER ST., CHICAGO
Closing link of marginal road quadrangle around Chicago "Loop" district which will bypass all through traffic and eliminate congested produce market traffic.

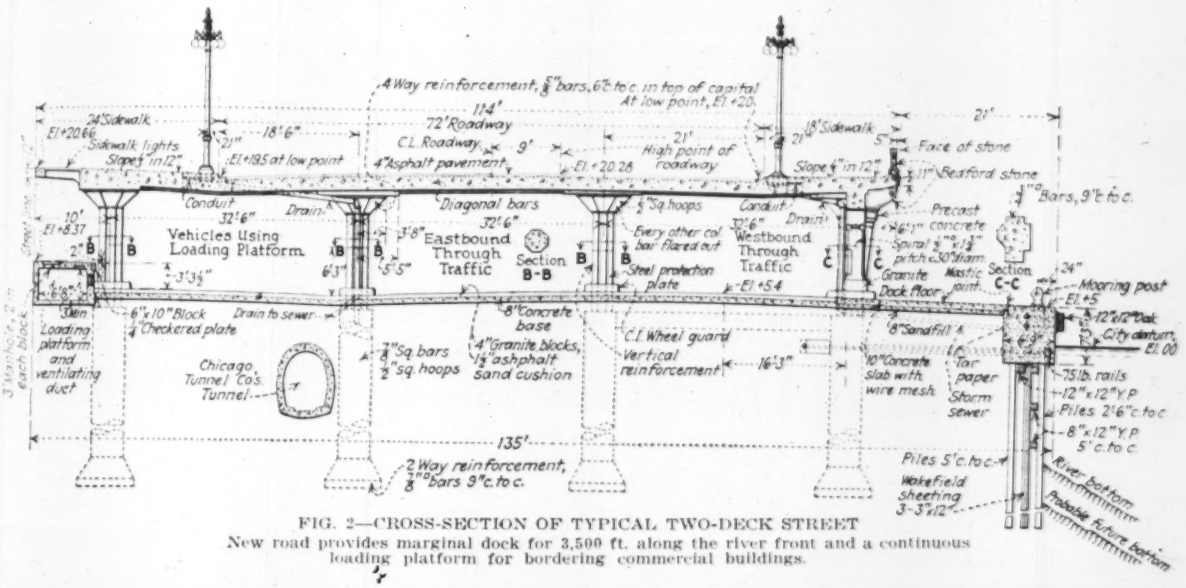


FIG. 2—CROSS-SECTION OF TYPICAL TWO-DECK STREET
New road provides marginal dock for 3,500 ft. along the river front and a continuous loading platform for bordering commercial buildings.

the design in a general way and describe the construction methods on the principal contracts so far let.

Design of South Water St. Structure—This double-deck structure of reinforced concrete is replacing in Chicago all the streets which border the south bank of the Chicago River from Michigan Ave. on the east to Lake St. on the west. These marginal streets, River St., South Water St. and Market St., are indicated by the general plan Fig. 1. They skirt the main stem of the river and the inner elbow where the South Branch connects. In all its length to Lake St., the structure provides a marginal dock as well as a two-level street. South on Market St. and on approaching streets it involves street widenings and ramps. Both plans and profiles are given by Fig. 1 and are referred to in the description following.

Route Plan—With approaching streets and bridges across the river to consider, the first problem was one of elevations. Lake Michigan has a range of level from 2 ft. below to 3 ft. above Chicago city datum in a cycle of seven years. Considering also wind tides and wave action it seemed desirable to put dock level at least 2 ft. higher than highest water or at El. +5. A clearance of 12 ft. 4 in. between decks was adopted. Adding this to the pavement thickness and street crown above dock level and adding 16½ in. average thickness of upper deck gave a top-of-deck elevation of +20 ft. As shown by the profiles this elevation fitted in about as well as any with existing street and bridge elevations, and except at Michigan Ave. gave no very steep grades from connecting streets.

Observing the plans Fig. 1, it is seen that seven streets besides Michigan Ave. and Market St. connect directly with the upper level and four streets connect directly with the lower level. Connection between upper level and lower level in the structure itself is only at the River St. and Market St. ends where ramps and grades are indicated on plans and profiles. Consideration of curves was essential chiefly at the Michigan Ave. connection. It was found that cars or trucks could readily travel a circle 40 ft. across and curves were limited in sharpness to 20 ft. radius and the vehicle way on curve was set at 9½ ft.

The plans indicate the variety of traffic routings which are possible. On the upper level traffic entering at the ends or

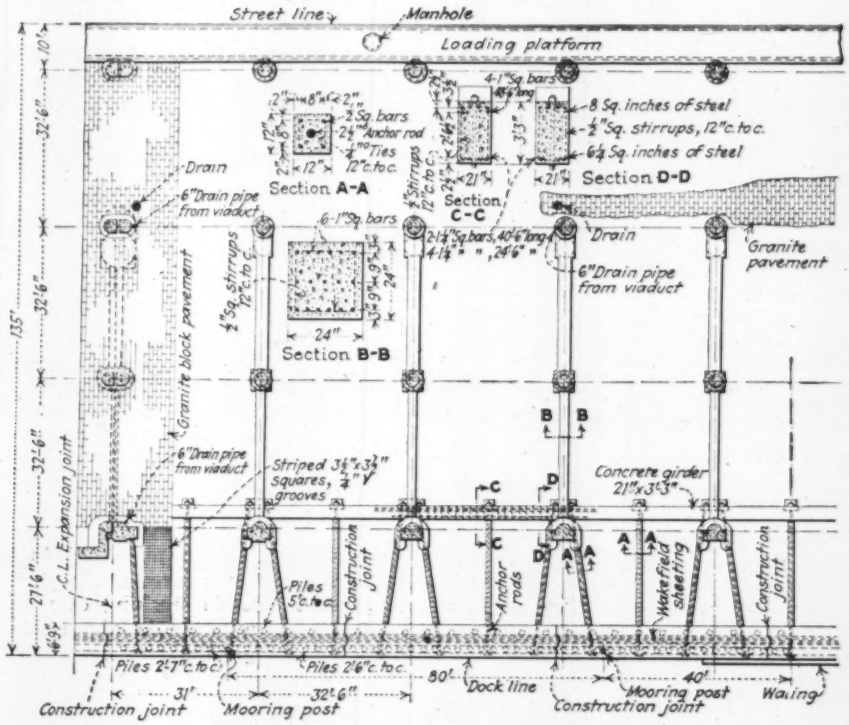


FIG. 3—PLAN OF DOCK WALL ANCHORAGE TO SHORE STRUCTURE

at any of the seven intersecting streets can leave by any other entrance. On the lower level traffic entering at the ends or at any of the four connecting streets can leave by any other route. At the ends entering traffic can take either the upper or the lower level. Transfer between levels is possible at the ends only. There is no rigid division of traffic but largely the lower level is a truck route and the upper level is a passenger car route.

FIG. 4 (Above)—TYPE OF STRUCTURE AT INTERSECTING STREETS
Flat slab gives way to slab and girder construction formed by continuing drop panels from column to column

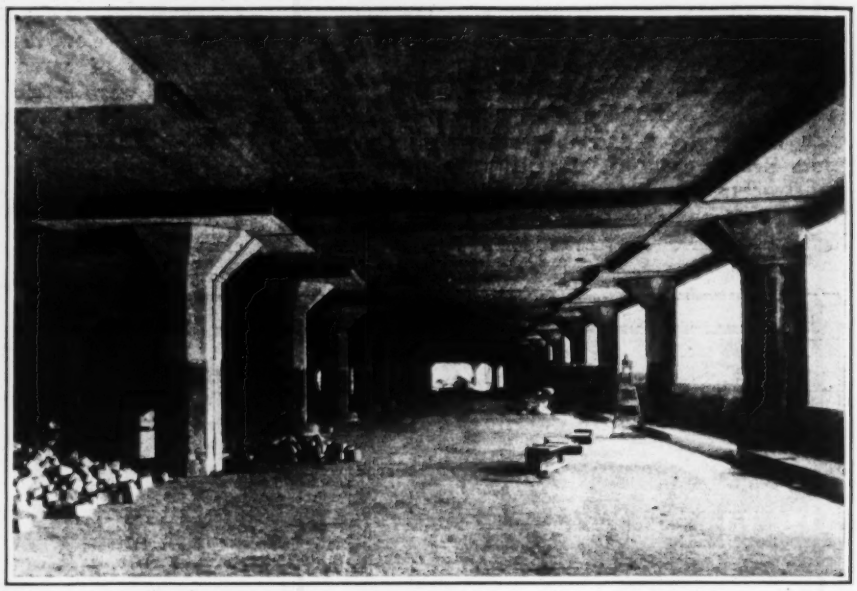


FIG. 5 (Below)—STANDARD FLAT SLAB STRUCTURE
Dock and river at right, granite block paving virtually complete; excellent finish of concrete as it comes from forms

Substructure and Dock — The conditions of site called for notable underground construction: (1) The ground along the south bank of the river is 40 ft. of soft clay on hardpan; (2) existing and projected intersecting underground structures had to be considered, and (3) along the whole water front a dock wall had to be tied into the shore structure. Figs. 2 and 3 show the working out of the problem. Briefly, for these conditions (1) piers were carried down through the clay to hardpan; (2) the dock wall was anchored back to, or framed integrally with, three lines of piers; and (3) piers were spaced to straddle planned or existing underground structures and then spanned between by girders to carry superstructure columns coming above the underground structures. Altogether in designing to meet future conditions about as elaborate a structure was required below the surface as above it. This called for an immense amount of detail and only main features can be mentioned.

The necessity of going through the 40 ft. of clay to hardpan could not, it was felt, be escaped if safe designing was to be paramount. Adjoining building basements were likely to go down into the clay and connections be made with the Chicago Tunnel Co.'s freight tunnel. There were sewers planned, particularly a 10x10-ft. interceptor between the first and second rows of columns. Again there was to be considered future excavation of crossing streets for the long contemplated underground rapid transit system. With an elastic clay, settlement from such excavations was to be feared and the logical safeguard was to found the piers on hardpan. Further it was felt wise to put only a moderate load of 7 tons a square foot on the hardpan, since it was held that the settling clay would by friction put heavy loads on the pier footings. This possible clay movement also was a factor in the pier design. Side pressure had to be designed for. It was assumed that the piers would take a horizontal earth pressure for a distance of approximately 26 ft. below dock level and the piers were reinforced, as shown by Fig. 2, to take side thrust. Also the piers next to the river were reinforced to take bending due to earth pressure against the dock-wall sheeting. The minimum diameter of piers is 4 ft. 3 in.

The dock wall carried on two rows of piles with sheeting between was designed as a heavily reinforced-concrete girder. The exceptional feature of design is the anchoring structure. This is best shown by Fig. 3. The point to be noted is that the tie rods, encased in concrete, are not attached to the piers but to a girder which bears against the rear faces of the piers. The purpose is to prevent possible cracking of piers and columns by a smashing blow to the dock by a ship. If now this happens the tie girders may be shoved back and the anchor girder broken but the piers carrying superstructure will not be injured. The tie girders to the second row of piers also distribute the

load. In detail there is little not shown by Figs. 2 and 3 to note except the location of the anchor rails with a bearing against the outside row of piles and the connection of the oak wales or fenders. The anchor bolts have at their outer ends turnbuckles coming flush to the girder face, and the bolts holding the timbers thread into these turnbuckles and so are easily removed to renew worn or broken fenders.

An important feature of the substructure is the provision of subgirders between piers which straddle existing or planned sewers or tunnels. These girders have been located as conditions required, principally at street intersections or where the Chicago freight tunnel runs or where sewers and other service conduits are planned. In some instances heavy construction has been required, as at Lake St., where there is a girder 48 ft. x 10½ ft. x 5 ft. 8 in., taking a load of over 310 tons.

FIG. 6—EXTERIOR OF NEARLY FINISHED SOUTH WATER ST.
Note the marginal dock and the ramp coming up to the top deck. Some idea of the monumental character is given even by this progress view

Superstructure and Pavement—The superstructure is a reinforced-concrete deck carried by columns arranged as shown in the lower level plan of Fig. 1. A section of the regular construction between State St. and Franklin St. is given by Fig. 2. Except at some few odd places where the panels are triangular or the spans are great the deck is a flat slab with four-way reinforcement. The odd panels are designed as beam and slab construction by extending as shown by Fig. 4 the drop panels, or portions of them, from column to column. City building ordinances were followed in all design. Octagonal columns 34 in. through with capitals flared to 7½ ft. were used. These were armored with wheel guards and unusually high, 6½ ft., steel hub guards cast in with the column. In the design, loading, bending and expansion joints call for principal notice.

Loadings and unit stresses used in Chicago bridge work were adopted and the stresses determined by the slope deflection method. Each section of structure between expansion joints, about 150 ft., was considered as a continuous rigidly connected structure and each column was assumed fixed at the pier. Temperature stresses were provided for on the assumption that there may be a change of 60 deg. At a few places near the Michigan Ave. end where there are three levels, with the lowest section of column very short it was found impracticable to use concrete because of excessive bending stresses from temperature, and steel was substituted. Indeed in the design of columns the most difficult problem was to provide for bending stresses. To keep these stresses within reasonable limits it was in fact necessary to extend the columns various depths according to the center of expansion down through the lower-level pavement. This is indicated in Fig. 2.

Cross structure expansion joints come about every 150 ft. At all street intersections joints are located 16 ft. east of and west of the property lines projected north from the south, and in the opposite direction, east and west, a joint is located on the line of the north row of columns and another on the south property line east and west. These joints cut off the rectangle of intersection from the other structure. Besides the joints at intersections there was one at mid-block between cross streets. Split columns as shown by Fig. 2 are used at expansion joints. In the slab the joint is a steel plate in one face sliding into a slab in the other face, the slab being filled with mastic. The curb and sidewalk joint construction was ordinary.

A provision not common for expansion was joints in the lower level pavement. Around each column was put a 2-in. mastic filled annular joint. Another was put between the dock floor and the wall girder. The pavement will be granite block on the lower level and on ramps and asphalt on the deck. Checkered concrete is used for the dock floor. The loading platform is concrete, and serves also as a sidewalk and a ventilating duct. Besides forced air ventilation the lower level will have light from lamps placed in the flares of the column capitals as well as daylight from the sides and from sidewalk lights.

As indicated on Fig. 2 the river face of the superstructure is designed attractively. Construction has not proceeded far enough for a finished view but Fig. 6, looking west from the Franklin St. bridge, gives a fair notion of façade, ramp and dock construction.

All design was worked out under the direction of T. A. Evans, engineer of design, Board of Local Improvements, John J. Sloan, president. The contractor for the portion of the work shown by the photographs is the Mid-Continent Construction Co., Chicago, Ill., F. J. Herlihy, president. Unusual equipment and construction progress have been developed on this work and will be illustrated and described in next week's issue.

Survey Shows How Niagara Falls Is Receding

Survey of 1925 Crest Line Made by Air Photos—Average Recession Is Less, but Maximum Is Greater, Than Formerly

This article is based on a letter from Major DeWitt C. Jones, District Engineer Lakes Division, through Colonel Spencer Cosby, Division Engineer, Lakes Division to Chief of Engineers, U. S. Army, Washington, D. C.—EDITOR.

IN THE period from 1764 to 1917 five surveys were made of the crest line of the Horseshoe Falls at Niagara. The accompanying map shows the position of the crest for each of these surveys and with the present crest line that has just been determined gives the erosion history of this part of the falls for the past 161 years. Whereas the previous surveys were made by intersecting points on the crest line from various transit points on shore, the 1925 crest line has been determined from an aëro-photo study of the falls. The results of this study appear to be highly satisfactory and an account of the methods used and conclusions reached is of importance.

Air Survey Methods—A considerable series of vertical photographs on a scale of about 1:4,000 was taken and, in addition, numerous oblique views were secured to aid in identifying points in the vertical photographs. After a careful study of the vertical photographs, six were selected as being most suitable for use in the production of the finished map and enlargements of these six photographs were made to a scale of approximately 1:2,000. From these photographs 10 control points were selected. The exact geodetic positions of these control points were then determined by taped traverses connecting with the U. S. Lake Survey's triangulation map.

A polyconic projection of the area to be mapped was drawn on celluloid on which the various control points were plotted. Along the crest line as seen in the different photographs, 26 points which could be absolutely identified on two or more photographs were selected; these were located on the celluloid sheet. Inasmuch as each of the photographs contained the whole crest line and also at least 5 of the control points, the projection of the map was a simple and accurate process. The greatest difference in elevation among the control points and plotted points was about 70 ft. All but two of the plotted points were located by the intersection of three or more lines. Two of the points could be identified in only two of the photographs and were therefore located by only two intersections. The line representing the crest line of the falls was then drawn through these 26 points using the photographs in determining minor irregularities between the plotted points. The crest line was then added to a map showing the five previous surveys which had been used in connection with the Report on the Diversion of Water from the Great Lakes and Niagara River dated Aug. 30, 1919. The resulting map is reproduced herewith. The lower case reference letters are from the Diversion Report and the upper case letters have been added to indicate points determined by the photo survey.

Comparison With Earlier Surveys—In all previous surveys it is probable that the line of sight from transit points on the shore as plotted on the finished map are more accurate than the intersection lines plotted from photographs. On the other hand, in the case of the photographic process it is perfectly easy to make certain that all intersecting lines are determined by exactly the same point whereas in the earlier surveys great difficulty was experienced in identifying points when seen from different points of view. In many instances considerable stretches of the crest line furnished no conspicuous points on which intersections could be made while in others some doubt existed as to whether the points intersected represented the exact edge of the crest line or merely spurts of spray or other conspicuous objects in the vicinity of the crest line.

On the whole, it is believed that the 1925 determination of the location of the crest line is of a slightly higher degree of accuracy than any of the earlier ones. Comparing it with the 1917 survey, there is reasonable agreement between the two, except in one vicinity. For about 600 ft. from the eastern end of the crest, the amount of water now flowing over the Falls is very small and the 1925 line coincides almost exactly with the earlier line. It might be added that this is the section easiest to cover by the old methods, and the 1917 line was probably very accurately determined here, which would imply an equal degree of accuracy for the photo survey. For the next 300 ft. the photo survey line lies 20 or 30 ft. in advance of the 1917 line. Inasmuch as a "negative recession" is obviously absurd, one or the other line must be in error in this vicinity (marked *Q R S* on the accompanying map). In 1923 The Niagara Falls Power Co. made a partial survey of the crest line. For the area in question their line agrees much more closely with the 1925 line than with the earlier one, which would seem to imply that the 1917 line contains an error at this point. Over the remainder of the crest, the new line is reasonably in accord with the old one. Small "negative recessions" occur at two points, but are apparently due to minor local errors.

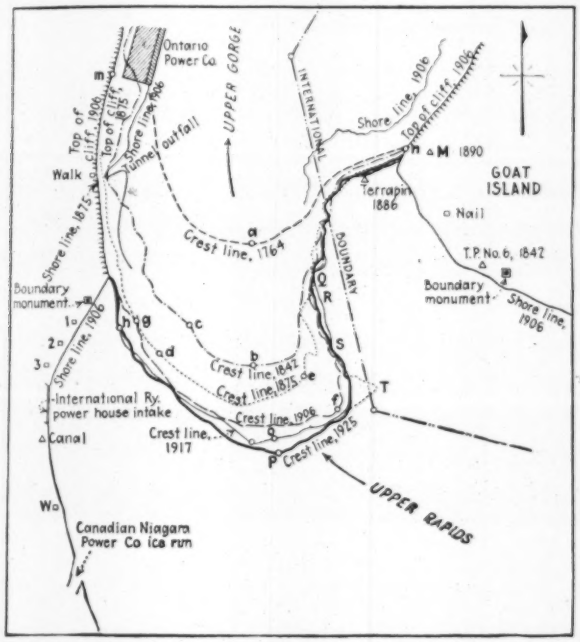
Recession of the Crest Line—The following statements as to the recession of the Falls as determined by the 1917 and earlier surveys are taken from the Diversion Report previously referred to:

"The exact measure to be used in expressing the rate of recession is a thing somewhat difficult to determine. In preparing Table No. 26 the following method was used: A line, *m-n*, was drawn from the east end of Montressor's crest line on Goat Island through the southwest corner of the Ontario Power Co.'s powerhouse to the west edge of the gorge. The length of this line, 1,200 ft., was taken as the ultimate width of the gorge, which the Falls is excavating. This agrees with the width based on two other measurements. Then the increase in the area bounded by this line and the crest line divided by 1,200 is the average amount by which the gorge has been lengthened in any given time. Dividing this by the length of time in years gives the average rate of recession. The maximum recession between any two successive lines was formed by measuring the length of the longest line that could be drawn between them as nearly as possible perpendicular to each. The points selected for the ends of these lines are indicated on the map by the lower case letters *a*, *b*, *c*, etc. Dividing their lengths by the elapsed time gives the maximum rate of recession."

RATE OF RECESSION OF HORSESHOE FALLS

	Elapsed Years	Area of Recession, Sq. Ft.	Mean Rate of Recession, Sq.Ft. per Yr.	Mean Recession, Ft.	Mean Rate of Recession, Ft. per Yr.	Line of Maximum Recession,	Maximum Recession, Ft.	Rate of Maximum Recession, Ft. per Yr.
From 1764 to 1842	78	380,000	4,870	317	4.1	a-b	470	6.0
From 1842 to 1875	33	202,000	6,120	169	5.1	c-d	160	4.8
From 1875 to 1906	31	124,000	4,000	103	3.3	e-f	180	5.8
From 1906 to 1917	11¼	44,000	3,910	37	3.3	g-h	75	6.7
From 1917 to 1925	7½	27,000	3,680	22½	3.1	o-p	55	7.5
Total from 1764 to 1925	161	777,000	4,820	647	4.0	a-p	820	5.1

The accompanying table is the same as Table 26 referred to in the Report except for a change in the figures from 1906 to 1917 and the addition of the figures for the period from 1917 to 1925. The recession given in the original Table 26 for the period from 1906 to 1917 was somewhat excessive on account of the error in the vicinity marked *Q R S*. This line of the table has been re-computed assuming that the proper location of this part of the crest line in 1917 lay between the locations determined in 1906 and in 1925. Because of the shortness of the elapsed time between the last three surveys it was thought desirable to take account of fractions of a year.



CREST LINES OF HORSESHOE FALLS OF NIAGARA RIVER

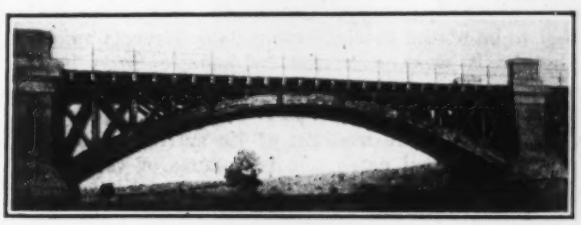
The 1764 crest line is from a survey made under the direction of Capt. John Montresor, Royal Engineers.
The 1842 crest line is from a survey made by James Hall for the State of New York.
The 1875 and 1906 crest lines are from surveys made by the United States Lake Survey.
The 1917 crest line is from a survey made by the Lakes Division.
The 1925 crest line is from an aerial photographic survey made by the 14th Photo Section, A.S., U. S. Army and the Buffalo Engineer District.

At the point marked *T* on the map a large notch has been found in the floor of the river close to the crest. The notch forms an irregular equilateral triangle about 300 ft. on a side. In some of the oblique photographs it can be seen that the notch does not extend to any great depth down the vertical face of the cliff. Although no recession is indicated at this point during the past eight years, it appears probable that this notch may have an important effect in determining the direction of the greatest recession in the immediate future. No information is at hand as to the time when this feature first appeared, but it is believed that it has not been in existence for any great number of years.

Conclusions—A study of the map and table indicates that since 1906 the amount of rock excavated by the Falls annually has been somewhat less than formerly was the case, but that the maximum lineal recession of the apex of the Horseshoe is greater than formerly. Apparently the reduction in the total excavation is due to the fact that the amount of water flowing over the Falls has been materially reduced by the diversion of water by the various power companies. This diversion amounted to about 15 per cent of the mean river flow in 1906 and has been constantly increased, until it now amounts to about 25 per cent. The increased rate of recession at the apex is probably due to the more pointed shape of the Horseshoe which concentrates a larger proportion of the flow into a limited length of crest line near the apex.

Timber Arch Bridges in Australia

THE renewal of some timber arch bridges on the New South Wales Government Rys., Australia, recalls an unusual type of structure which was used extensively at one time. In these bridges, with four and five arches of 81½-ft. span and 12½-ft. rise, each arch consists of three ribs built up of ironbark planks 15 x 3 in., with a thickness of eight planks at the crown and twelve planks at the spring line. The planks are bolted together and the ribs are seated in cast-iron shoes on the masonry piers. Six 1½-in. transverse rods pass through the three ribs and have 5-in. spacing sleeves with end plates bearing against the inner faces of the ribs. Spandrel posts and bracing, seated in cast-iron shoes, carry 12 x 12-in. longitudinals which are secured to the ribs by vertical rods and across which are laid transverse deck timbers. Upon these timbers are the longitudinals for the rails, with planking between to form a continuous floor. The bridges, built in 1884-1887, were designed to carry locomotives of 75 tons weight, including the tenders, and having 14-ton axle loads, but they now carry 127-ton engines with 17½-ton axle loads. According to the *Railway Gazette* of London, reconstruction was made necessary by the increased loading and the decay of the planks in the ribs and at the end shoes.



OLD PLANK-ARCH RAILWAY BRIDGE

Troubles with Waterweed in Open Shallow Reservoir

Bulbous Growth Spread Rapidly When Lake Was Drained at Seeding Time—Harvest with Submarine Saw and Huge Boom Rake

By E. G. Ritchie
Engineer of Water Supply, Melbourne, Australia

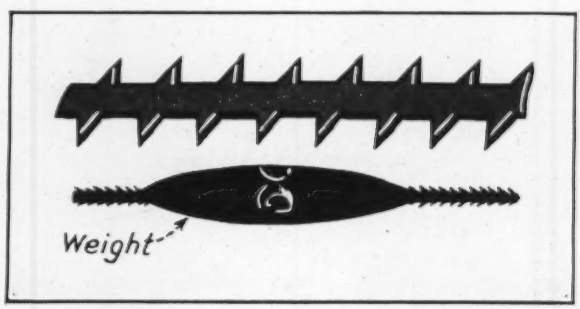
In 1885 the Toorourrong reservoir supplying water to Melbourne, Australia, was created by constructing a bank about 1,000 ft. long and generally 11 ft. in height across a flat below the confluence of two mountain streams. At the point where the dam crosses the old creek bed it is 23 ft. in height. The object of this reservoir is to establish an equalizing effect on the flow of these two streams prior to their diversion into the main intake channel leading to Yan Yean reservoir, which has been the principal storage basin of the Melbourne water supply system. The reservoir also acts to a considerable degree as a sedimentation basin. The foundations for the embankment were very bad, especially near the old creek crossing, and it was not considered desirable or necessary for the purposes in view to build a higher structure than 23 ft. at this point. Trees growing in the submerged area were not grubbed but were cut off to within 6 in. of the natural surface. The depth of water on a total area of 40 acres varies only from a few inches up to 6 ft., except where the depth is 23 ft. in a very small area.

For many years growths of reeds and rushes were confined to the shallowest water around the margins of the lake and one man kept them under control by intermittent cutting. In one of the shallow bays was a small patch of weed which was different from other species of waterweeds in the lake. This patch did not extend for many years but suddenly in the spring of 1915 it spread all over the lake wherever the water was shallower than 4 or 5 ft. Thereafter it grew apace and its cutting became very expensive, especially as cutting did not prevent its early re-establishment.

Advice was sought from Dr. A. J. Ewart, professor of botany at Melbourne University. He declared the weed to be of the species known as *vallisneria spiralis*. Whether it was introduced by aquatic birds in the original patch could not be stated, but as a result of his inquiries Professor Ewart was able to point out what had been the medium of its active propagation from the original patch. It is because of the lessons to be derived from this incident that the occurrence is of special interest.

Accumulations of fine silt had gathered around the reservoir outlets to such an extent that it was deemed desirable to effect their removal, which could most conveniently be arranged by lowering the water in the reservoir so as to expose the banks of silt. This lowered water level exposed large areas of other silt beds all over the lake. The period chosen for lowering the water, the late summer of 1914, while convenient from a water delivery point of view, was an exceedingly unfortunate one from the point of view of propagating the growth of *vallisneria spiralis*. Professor Ewart explained that this weed can extend its growth in two ways, (1) by lateral stolons rooting at their ends under water, a relatively slow method, or (2) by seeding. The seeds are very small and as emitted from the flowers at the water surface have the appearance of a fine white pollen. The period of seeding, when the fine seeds were distributed all over the water surface of the lake, synchronized with the lowering of water to remove silt at the outlets of the reservoir. In this manner it came about that the receding water had deposited the seed all over the silt beds of the lake as these became exposed and next spring the weed grew everywhere.

Once established *vallisneria spiralis* is most difficult to remove. It is possible that dredging the entire lake may accomplish the removal of the bulbular root system, or that the draining of the lake and a thorough drying up in hot weather would kill these roots. Neither of these measures is, however, convenient, as they would throw the reservoir out of service as well as destroy the valuable fish life in the lake. The only practicable measure to keep the weed in check has been a periodical cutting. It was soon found that cutting blades which had a "sawing action" were necessary as, otherwise, the weed, which is very soft and pliable, would pass under the knives. About this time an illustration appeared in *Engineering News-Record* [reproduced herewith—Editor] of a "submarine weed cutting saw" devised and sold by Aschert Bros., Los Angeles.



FLEXIBLE SAW FOR CUTTING SUBAQUEOUS WEEDS
Reproduced from cut in *Engineering News-Record*, Feb. 14, 1918, p. 305.

One of these saws was purchased and has been used for cutting the weeds most effectively. It consists of a narrow steel band, somewhat similar to a surveyor's tape but stiffer, and has a sawtooth on one edge. [The illustration shows sawteeth on both edges, but the device may have been modified for use in Australia.—Editor.] It is weighted with sinkers at intervals so that it can lie close along the bottom of the reservoir. It is operated by two boats in each of which one man is rowing and, in the stern, another man pulls the line of the saw which is drawn backward and forward between the two boats. In this manner large areas of weeds have been effectively and economically cut. The saw is subject to frequent breakages as a result of striking old projections of stumps and tree roots in the bottom of the lake. These breakages can, however, be mended readily.

The cutting of the weeds is only a part of the general problem, the most expensive operation being the collection and removal of the floating cut weeds, which the wind blows all over the lake. They collect in shallow bays where they would soon decay and become a factor of water pollution if not promptly removed. The use of ordinary fishing nets to surround and drag the bunched weeds to chosen landing places was contemplated, but the slightly irregular nature of the reservoir

floor and the small projections of old tree roots and stumps defeated this plan. The most effective method has been found to be the use of a floating wooden boom made flexible by constructing short sections of straight booms with hinged junctions. Each boom section has a series of steel bars in it which give it the form of a floating rake. At each end of the boom is a rope used to drag it, with its collection of weeds, to suitable landing places on the shore. At the landing places is a movable crane with grapple bucket to lift the weeds to trucks or other vehicles for removal and disposal.

The writer would be interested to learn whether other engineers have had to deal with weed cutting and removal under similar circumstances, and could advise him of better or more economical methods than those described. It may be of service to others who may contemplate the establishment of shallow pond or lake areas to make the following observations: (1) Sooner or later such shallow lakes are likely to become infected by weed growths. (2) The cutting, collecting and removal of such growths will be greatly hampered by irregularities in the floor of the lake. (3) It will therefore be found to pay well in the first instance, to grub completely all tree stumps and roots, remove large stones and otherwise leave the lake floor perfectly clear of all obstructions. It is a troublesome and expensive matter to do work afterward in the presence of deposits of silt.

New Reclamation Progress Delayed by Unfavorable Local Conditions

REFUTING Western charges that the Bureau of Reclamation has failed to carry out the directions of Congress to construct certain new reclamation projects, or has delayed unduly, a statement just issued by the Bureau gives the status of the projects and sets forth the causes of delay for which Western authorities are responsible. The projects mainly in question are the Kittitas division of the Yakima project, Washington; the Sun River project, Montana; the Vale project, Oregon; and the Spanish Springs division of the Newlands project, Nevada. In each case the congressional appropriation contained a proviso that the state co-operate in settlement and farm development, but not one of the states has agreed to co-operate.

For Kittitas $750,000 out of a total cost of $11,000,000 was appropriated. All plans are completed except a soil classification. The state of Washington has declined to assume the duties required of it in connection with settlement and farm development.

For the Sun River project $500,000 out of a total of $5,000,000 was appropriated, and plans for the work are completed, but Montana has declared that it cannot recommend legislation needed for compliance with the state co-operation proviso of the congressional appropriation. A scheme is being developed for a local private syndicate to underwrite the state's obligation in this respect, and there is some prospect that this plan may go through.

For the Vale project, to cost $3,600,000, a sum of $500,000 was appropriated. More than a third of the land is held by two private companies, and it will be necessary under the law for these companies to agree to sell their holdings in excess of a homestead to settlers at an appraised price. Such agreements have not yet been made. Moreover the federal government must purchase an interest in the reservoir of the Warm Springs irrigation district, which purchase is subject to certain questions that can be settled only by litigation. The state authorities claim that they are without authority to enter into a contract with the government to assume the duty and responsibility of settlement and farm development after the project is completed. Because of these obstacles, the Bureau of Reclamation has not been able to proceed beyond completion of plans.

Nevada has similarly declined to undertake such responsibility in the case of the Spanish Springs extension project, for which $500,000 of the total cost of $6,000,000 were appropriated. As an additional difficulty, soil questions and doubts surrounding existing power rights remain to be determined here, and contracts must be arranged with the Indian holders of reservation land included in the area that is to be irrigated.

The last Congress also made an appropriation for the Baker project, in Oregon, which like the other appropriations is subject to favorable conclusions as to the economic feasibility of the project. The bureau has concluded from its investigations that the project is not feasible and would probably not return its cost to the government. The Department of the Interior has therefore declined to expend any further funds on the project, and it has been sustained in this position by an opinion of the attorney general.

Referring to the Salt Lake Basin project, in Utah, where it has been decided to construct the Echo Reservoir for storing floodwaters of the Weber and Provo Rivers, the Bureau's statement sets forth a rather different situation. Here the land to be irrigated is all settled and developed into highly improved farms, but the water supply (from private ditches) is inadequate. Plans and estimates for the construction work have been ready for months. However, the local organization, including some of the ablest business men in the state, has not yet been able to organize the water users and make the necessary financial arrangements to insure repayment of the $3,000,000 cost of the desired works.

That economic conditions affecting reclamation also counsel caution in undertaking the new projects is indicated by a review of land classification on the Newlands project, in Nevada, just made by Prof. Charles F. Shaw, professor of soil technology at the University of California. The classification was made by a local co-operative committee of farmers. It covered practically the full area now operated. Permanently unproductive lands amount to 32,313 acres, it is found, while productive lands (including areas that are temporarily unproductive) total 74,605 acres. But only 61,607 acres are now under water-right contract. In 1924, 44,280 acres were irrigated, less than 41,000 were in crop, and 36,610 were in full production. Based on the latter area, the gross crop returns per acre were $37.02.

The lands are lake bottom and river bottom lands, and have poor natural drainage. Over half the area is made up of light soil of uneven topography, which requires large expense and effort to level the land for irrigation and has resulted in more or less spotted fields. In addition, alkali accumulations are common and expensive, and the report says that "the absence of alkali from land should be proven before attempting development."

At the time of the original promotion of this project, a quarter century ago, irrigation of an area of about 300,000 acres was contemplated.

Apparently things are shaping for a battle royal over the reclamation policy. Under the leadership of Senators McNary and Stanfield, of Oregon, an unexpected amount of opposition to the program of Secretary Work and Commissioner Mead has developed. In certain instances where agreements had been reached, under which settlers were to retire some of their indebtedness, the recently-made commitment has been repudiated. The outbreak unquestionably has sufficient impetus to force the questions involved into the floor of Congress.

Dr. Mead expresses himself as being more than willing to have a show-down at the earliest opportunity. He believes that any vote that may be taken in Congress on the question will prove conclusively that a majority of the law-makers oppose blanket relief and any new projects until the existing ones can be put on a self-sustaining basis.

Secretary Work has a large number of testimonials indicating that many substantial interests in the West, some of whom would enjoy immediate profits were the new projects built, are supporting his policies.

Heavy Rolled Asphalt Pavements in Chicago

Less Bitumen, More Dust, a Thinner Top, and Harder Rolling Adopted to Reduce Shaving and Rutting

BITUMINOUS pavements have been stiffened up generally in recent Chicago street work to meet the tendency to shove and rut under heavy bus and truck traffic. In the old specifications the bitumen content was 11.00 to 13.50, without distinction for traffic conditions, and the dust content was 11.50 to 15.00. The new practice cuts down the bitumen and increases the dust as shown in the table, which also shows a more rigid sand grading than is usual. The penetration of bitumen was also reduced from a range of between 30 and 100 to between 25 and 70.

Besides a stiffer mixture, a very materially increased compression has been adopted particularly in sheet asphalt work. Here, first, a greater initial compression has been provided by a change from the use of a small roller to that produced by means of a three-wheeled roller, weighing not less than 10 tons, or a tandem roller weighing not less than 15 tons. Second, the thickness of the wearing course has also been decreased from a commonly specified thickness of 2 in. to that of 1½ in., and the binder course increased from a depth of 1½ to 2 in. The size of the stone in the binder course has been increased and the grading changed to correspond.

TABLE — COMPOSITION OF SHEET ASPHALT AND ASPHALTIC CONCRETE MIXTURES FOR CHICAGO PAVEMENTS

	Sheet Asphalt — Light	Sheet Asphalt — Heavy	Asphaltic Concrete
Bitumen, soluble in carbon disulphide	9.5 to 11.0	10.0 to 11.5	6 to 8
Levigated stone passing a 200-mesh sieve	16.0 to 20.0	12.5 to 16.0	8 to 12
Sand passing an 80-mesh sieve	20.0 to 36.0	18.0 to 36.0	10 to 20
Sand passing a 40-mesh sieve	25.0 to 40.0	25.0 to 45.0	10 to 20
Sand passing a 10-mesh sieve	6.0 to 20.0	8.0 to 20.0	10 to 20
Sand passing a 4-mesh sieve	.0 to 5.0	.0 to 5.0	.....
Crushed granite or traps passing ½ in.	.....	.....	15 to 30
Crushed granite or traps passing ¼ in.	.....	.....	15 to 25

The mixture in the concrete base for asphalt pavements as well as for other types has been changed from 1:3:7 to a mix approximately 1:3:6, requiring 4.2 sacks of portland cement to each cubic yard of concrete in place. The upper surface of the concrete foundation is required to be roughened to provide a proper key for the asphaltic course instead of finished smooth.

Changes in asphaltic concrete are practically along the lines followed in the case of sheet asphalt except that no binder is specified. In the asphaltic macadam pavement the foundations of 10 in. of waterbound base are all now being laid in two courses, both of which are thoroughly bonded with limestone screenings. Graded slag is required instead of crusher run. Likewise the metal for wearing course is changed from limestone to trap rock or granite.

ROLLING SHEET ASPHALT WITH 10-TON AND 15-TON ROLLERS

These new pavements are being put down this year by the Board of Local Improvements, Chicago, John B. Hittell, chief engineer of streets.

Iron Bacteria and Water-Pipe Incrustation

Studies of the corrosion and tuberculation of the interior of cast-iron water pipes reported by Prof. David Ellis before the Engineering Section of the British Association first led him to think that the nodules were built up by iron bacteria from iron in the water flowing through the pipe. On carrying his studies further he concluded that wherever "nodules in colonial form" were found they came from the iron of the pipe, through thin spots in the casting due to "the uneven nature of the iron surface when" coated with tar. Continuing, according to the London *Surveyor* of Sept. 18, p. 241, Prof. Ellis said he had never "known a hard iron incrustation" in pipes "of any other material than iron." Consideration should be given to "the indirect effect" of "large numbers of bacteria of all kinds in promoting the oxidation of iron" to ferric hydroxide, particularly when the water contains much organic matter for the sustenance of the bacteria. Multiplication of bacteria under such a condition "brings in its train a change in the constitution of the water, with "liberation of carbon dioxide." In contrast with the incrustations, "the softer, more shiny, ferruginous festoons and streamers which sometimes gather in water pipes," said Prof. Ellis, "the iron appears to come directly from the water."

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

For Every Water-Works Man

WATERWORKS PRACTICE: A MANUAL—Issued by the American Water Works Association. Baltimore, Md.: The Williams & Wilkins Co. Cloth; 6 x 9 in.; pp. 790; line drawings, graphs and tables. $5.

Within a little over five years, the Council on Standardization created in June, 1920, by the American Water Works Association, has, through the aid of numerous committees and the co-operation of scores of individual members of the association, produced a remarkable volume embodying current water-works practice and giving at the same time a considerable historical background. The achievement is one that has seldom been equaled by a technical society. The participants are so many that it would be out of the question to give credit to all of them here (that is done in the volume itself) but it is readily possible to give the names of the members of the Council on Standardization. The chairman throughout has been George W. Fuller. The only other member of the Council that has served for the entire period beginning in 1920 is Frank A. Barbour. Both Professor Edward Bartow and George A. Johnson served from 1920 to 1924. Other members of varying periods of service have been W. W. DeBerard, Edward E. Wall, and George C. Whipple. Malcolm Pirnie has been secretary from 1921 to date and the heavy burden of editorial work on the book itself has been carried by Abel Wolman, beginning in 1924.

After a general introduction, which includes a historical summary with statistics on water-works growth, the book falls into seven main divisions. These take up collection of water, quality, treatment, distribution, the financing and management of water-works, and fire protection. The appendix gives a number of standard forms, methods of procedure, specifications, etc., a standard agreement for engineering inspection (the work of a joint conference on standard construction contracts) composed of delegates from various associations, and also the National Board of Fire Underwriters' standard schedules for grading cities and towns of the United States with reference to their fire defenses and physical conditions.

Under collection of water there is a systematic review of state control of allocation of water supply between various communities, a discussion of yields and storage, and sections on watershed protection, industrial wastes and ground water. The division on quality of water supply, besides other matter, gives in full the United States Treasury or Public Health Service standards and supporting documents by the advisory committee. Under treatment both natural and artificial agencies are taken up and accounts given of the various properties. The division on distribution deals with pressure tunnels and pipe, high-pressure fire systems, boiler rooms and pumping stations, plumbing, pipe corrosion, including electrolysis, and finally water consumption and waste. Included under financing and management is an extended discussion of water charges, meter rates, taxation, price trends and financial status of water-works, valuation of water-works and related matters and other topics coming under operation. The section of the book relating to fire protection summarizes annual fire losses in the United States and elsewhere and goes into detail in the matter of charges for both public and private fire protection.

All those who have followed at all closely the work of the Council on Standardization and its associated sub-committee know the pains that have been taken throughout to make the contents of the book readily understandable by those superintendents and other water-works officials who have not had the advantage of engineering or other technical training. We hasten to add that the book does not suffer any in usefulness to technically trained men on this account.

So commendable a volume should receive the appreciation and support of the entire water-works fraternity, whether or not they are members of the American Water Works Association. A great effort was made to keep the volume down in size so it could be manufactured and sold at a price well within the purse of every water-works man. To gather and condense the vast amount of material that has been used in this volume and make it available for $5 is in itself a notable achievement.

Commodity Specifications

NATIONAL DIRECTORY OF COMMODITY SPECIFICATIONS: Classified and Alphabetical Lists and Brief Descriptions of Existing Commodity Specifications. [Miscellaneous Publications No. 65, Department of Commerce, Bureau of Standards.] Cloth; 8 x 11 in.; pp. 379. $1.25 from Superintendent of Documents, Washington, D. C.

Over a year ago the Department of Commerce, in co-operation with a number of technical and commercial organizations, entered into the compilation of the thousands of commodity specifications formulated by public purchasers and by nationally recognized trade associations, technical societies and public utilities. The current book is the result of the work of the department. Specifications are not given in the book. They are merely listed, but it takes well towards 400 pp. of good sized type page to complete the list. The entire field of commodity use is apparently covered, with subdivisions which readily classify any particular commodity.

Following the publication and distribution of this directory, there will be issued as rapidly as conditions will permit an encyclopedia of specifications in loose-leaf or loose-pamphlet form, and it is noted that in preparing material for the encyclopedia efforts will be concentrated initially on reproduction of such worth-while specifications as are difficult to secure.

As an indication of the extent to which specifications are issued, it may be noted that one subject, portland cement, for which there is an American standard issued by the American Engineering Standards Committee and to which theoretically all cement is manufactured and on which theoretically all cement is bought, has listed here 54 separate specifications. Doubtless many of these are A.S.T.M. specifications which have been

adopted by the American Engineering Standards Committee. Nevertheless, they are issued as separate specifications.

As an indication of the possibilities of standards reduction, the book is interesting. Its main value, however, is to the prospective purchaser who is desirous of securing the best standard possible for his purchase.

Chapters for Small Contractors Added

PRACTICAL ACCOUNTING FOR GENERAL CONTRACTORS—By H. D. Grant, Staff of W. B. Richards & Co., Accountants and Engineers. Second Edition. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 329; charts, and reproduction of accounting and legal forms. $3.

Commendation was made of this book in its original form as reviewed in *Engineering News-Record*, Aug. 17, 1922, p. 284. The new edition extends the usefulness of the old by including a special discussion in four chapters of accounting procedure for small contractors. It is a simple system but it is gratifying to note, as we noted of the first edition dealing with accounting for contractors handling large operations, that the author makes no claim to give kindergarten cost keeping for the contractor himself to learn and employ. He presumes ordinary bookkeeping experience and assumes the employment of a bookeeper to handle the accounts.

First Volume of New Taylor and Thompson

CONCRETE, PLAIN AND REINFORCED, Vol. I: Theory and Design of Concrete and Reinforced Structures—By the Late Frederick W. Taylor, Sanford E. Thompson, S.B., and Edward Smulski, C.E.; with a chapter by Henry C. Robbins. Fourth Edition. New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 969; 311 line cuts and halftones in text, section of tables and diagrams. $8.

The first edition of Taylor and Thompson was written in 1905 and was therefore one of the pioneer texts on the then new subject of reinforced concrete. In 1916, an elaborate revision of the treatise was made by Mr. Thompson after the death of the senior author, Mr. Taylor. The present so-called fourth edition, by Mr. Thompson, with the assistance of Mr. Smulski, is a still more elaborate and complete revision. Inasmuch as the early one volume has now been changed to three volumes, of which Vol. I is so far the only one issued, it would not be fair to pass judgment on the whole book until the three volumes are available. It can be said, however, that Vol. I, with its nearly 1,000 pp. of text, promises a monumental treatment of the subject of concrete, both plain and reinforced.

This volume is devoted entirely to the theory and design of concrete and reinforced-concrete structures. Except for a preliminary short chapter on materials and methods, another shorter one on reinforcement, and a fairly complete description of some classic tests of reinforced concrete, the whole book is devoted to the theory and practice of design. This starts off with a general chapter on the now accepted methods of reinforced-concrete analysis which are clearly written and which have furthermore the value of accompanying comment on the detail application of the methods of design to specific conditions. There follow chapters on flat-slab structures which on account possibly of the great interest of the junior author in the revision, Mr. Smulski, in the subject, are exceptionally elaborate, on columns, on foundations and footings, piles, building construction, wall-bearing construction, basement walls, roof construction, building details, architectural treatment (by Henry C. Robbins, an architect), theaters and auditoriums, various types of buildings, chimneys and retaining walls. The concluding chapter is devoted to a number of tables and diagrams for assistance in design.

Considered as a text-book, the volume contains a great number of illustrated examples of design, carrying through in considerable detail the exact processes which should be used. For the practitioner, in addition, there are a number of excellent suggestions by the authors drawn from their own experience and carefully indicated as the author's suggestion as to methods and practices. This is a particularly noteworthy thing in the book, for too often authors set down certain practices as though they were handed down by some all-powerful intelligence rather than noting them merely as the individual view of the expert who is the author of the book. When the individual suggestion is given, as do Messrs. Thompson and Smulski, the reader is forewarned and can take the suggestion in the spirit in which it is given.

Unemployment and Other Labor Problems

THE REGULARIZATION OF EMPLOYMENT: A Study in the Prevention of Unemployment—By H. Feldman, Ph.D., Assistant Professor, Industrial Relations, Amos Tuck School of Administration and Finance, Dartmouth College. Published under the auspices of the American Management Association. New York and London: Harper & Brothers. Cloth; 6 x 8 in.; p. 437; index. $3.50.

LABOR RELATIONS IN INDUSTRY—By Dwight L. Hoopingarner, M.A., Executive Council on Industrial and Commercial Relations; Executive of the American Construction Council; Director of the New York Building Congress. Formerly Lecturer in the Graduate School of Business Administration, Harvard University. Chicago and New York: A. W. Shaw Co.; London: A. W. Shaw & Co., Ltd. Flexible; 6 x 9 in.; pp. 553; graphical charts, case problems, index. $6.

Professor Feldman has made a more simple book of a complex subject than have most writers on unemployment, seasonal employment, labor insecurity, employment regulation and what not of the terms applied to the fact that most workers do not work regularly or continuously or with a feeling of security in their jobs. There are three parts and sixteen chapters to his book. Of these the first chapter, on the growing insecurity of employment, and the last chapter, on means for regularizing employment, should be read by every engineer, contractor and public works or public utilities official. To the engineer-constructor the section of Chapter VIII on construction unemployment and the beginning and closing chapters are of most direct value. The other chapters have more direct interest to the sociologist and the manufacturer.

Those engineers and contractors who seek a philosophy of labor relations will find Mr. Hoopingarner's book of noteworthy interest. In an introductory chapter the author gives a basis for developing a general point of view on labor relations. In the next two chapters an analysis is made of the major problems involved, and the fundamental economic considerations are discussed. Then follows a discussion of the psychology of the worker. The important subject of the control of labor relations is covered in a series of chapters on control through co-operative management, labor unions, employers' associations, legal control, public control, and the effect of education on industrial control. Then follows a discussion of earnings, divided into a consideration of wages and of profit-sharing. In the next three chapters the author shows the relation between hours of work, the labor supply and unemployment, pointing out the causes and effect of unemployment and suggesting

solutions. This part will most interest contractors. Next follows a discussion of health conservation, bringing to light the present phases of health and safety work and the extent and scope of industrial rehabilitation. The remaining chapters of the work the author devotes to the special social and international considerations connected with labor relations. The discussion of social insurance, child labor, industrial housing, the plant department of labor relations, personal analysis, labor loss, and international labor relations and world trends complete the volume except for appendices giving case problems and a notable bibliography.

Legal Rights of Public Utility Companies

PUBLIC UTILITIES AND THE LAW—By William M. Wherry, Jr., of the New York Bar. New York: The Writers' Publishing Co., Inc. Cloth; 5 x 8 in.; pp. 337; index and table of cases. $3.

Mr. Wherry has written an excellent legal analysis of the law of public utilities as it relates to the question of rates, but like all legal analyses written by a member of the bar or an occupant of the bench, it suffers too much from the "on the other hand" attitude to please the result-seeking engineer. This is no criticism of the lawyer or of the author, because it must be admitted that the present state of regulation of public utility rates is so chaotic that no pronunciamento can be made regarding its principles. As the author well points out, we are in a rapidly changing state regarding the operation of public utilities. There is a tendency toward unified control. There is a marked engineering progress toward efficiency by larger units and better interchange. There is a changing financial structure, mainly looking toward greater units. There is the problem of local, state, and national control. All in all, there can be little hope that the problem of rate fixing is stabilized. We are working in a changing age. Therefore, the author's book is not an attempt to crystallize a known subject, but it is, as he himself says, an exposition made as simple as possible of the rights of the public utility companies to make and obtain profitable rates for their services without state interference.

The author discusses various decisions on such questions as amortization of losses, relation of rates to services, the rate base, accrued depreciation and going value, the rate of return, operating expenses, and the distribution of rates. He then analyzes the indeterminate permit, comments on certificates of convenience and necessity, and submits a new form of public utility bill which he himself has devised. The comment is concise and scholarly and the suggestions as to future practice eminently fair to every one concerned. Only one suggestion seems a little doubtful. That is the author's attempt to conciliate the two opposing theories of rate base, both of which apparently have been held in conflicting decisions of the Supreme Court; the one which contends that the base should be the value of the property at the time the rate is determined, the other that it should be the so-called prudent investment in the property. The author would reconcile these two by considering prudent investment in terms of the current dollar, applying to the original prudent investment an index number to bring that investment into line with current values. At the same time, the author admits that no rule for a rate base is inflexible, but that in establishing such a base all of the many elements which go into the case must be considered. This view, incidentally, it may be noted, is the one taken by the Supreme Court and is the view which makes it so very difficult to determine in any particular case what is a rate base.

Taken as a whole, the book is stimulating and should be read by all engineers who are considering rate problems.

St. Lawrence Power Development Project

STATEMENT AND ENGINEERING REPORT BY THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO. Submitted to the International Joint Commission, Respecting the Proposal to Develop the St. Lawrence River, 1921 [but published in 1925]. Toronto: The Hydro-Electric Power Commission of Ontario. Cloth; 7 x 10 in.; pp. 119 (not including plates); 13 black-and-white and colored plates and maps. $7.50.

In 1921 the engineering force of the Hydro-Electric Power Commission of Ontario made an elaborate report on the possibilities and details of a power development of the St. Lawrence River between Lake Ontario and Cornwall. That report, together with some footnotes bringing the information up to date, has just been issued in a limited edition (issued, the commission states, in order that it may be placed on file in prominent public reference and governmental libraries). It covers the full project of the Ontario Hydro for the development of the river within the boundaries of the province. The report, in addition to presenting details of three alternate development schemes, analyzes the power demand in some detail. The schemes proposed are a single-stage development at Barnhart Island, a two-stage development at Morrisburg and Barnhart Island, and a two-stage development at Crysler Island and Barnhart Island. To all these are appended the details of a co-ordinate navigation scheme. Final choice in the report is not made between the single-stage and double-stage developments, but is left for future decision. Costs as estimated in 1921 give capital costs for electrical horsepower for 24 hr. at around $95 and a total cost for power from $141,000,000 to $154,000,000, with navigation costs running $68,000,000 to $59,000,000, respectively, making the total for the whole project over $200,000,000 as then estimated.

Fascinating Reminiscences

LOCATING THE IRON TRAIL—By Edward Gillette. Boston: The Christopher Publishing House. 6 x 9 in.; pp. 172; 23 half-tone plates. $2.

It has often been said that if the older engineers of the country would write of their experiences in the field of engineering the results would be more fascinating than fiction. Such is true of Edward Gillette's "Locating the Iron Trail," a book of reminiscences dealing with his experiences as a government engineer in the Southwest in the late seventies, and later as an engineer on railroad reconnaissance and location.

The purpose of the book, according to the author, is to call attention to the great developments in the West that followed the coming of the railroad and to point out the dependence of the country upon these same railroads. But, for engineers, the value of the book lies in the fact that it is a record of some of the everyday experience of engineers in pioneer work in the West. Many such records which might have been written are now lost through the passing of the engineers who made them and it would be well if other engineers could be encouraged to follow Mr. Gillette's example.

Edward Gillette's work as an engineer covered a wide range of country from New Mexico north to the

Dakotas, through the Northwest and to Alaska. It was as varied as the country traversed and the writing of his description of it is so well done that the book makes absorbing reading. It lacks a few good maps to make it easier for readers to follow Mr. Gillette through the days of his pioneering in the West.

Regulation of Public Utilities

GUIDING PRINCIPLES OF PUBLIC SERVICE REGULATION—By Henry C. Spurr, Editor of Public Utilities Reports. Vol. I. Rochester, N. Y., and Washington, D. C.: Public Utilities Reports, Inc. Cloth; 6x9 in.; pp. 752; Table of Cases Cited; full index. $7.50.

Those who wish a digest of both commission and court rulings on the regulation of public utilities will find this volume useful. After a brief review of the origin and growth of commissions and their powers, the author deals with the control of utilities in general, security issues, accounting, rates, and various services. Limitations of commission control and distinction between the powers of commissions and of courts are next considered. There follow discussions of the various elements of rate control and valuations for such control. Compared with most of the books on utility control this one gives unusual attention to the rulings of the commissions, bearing in mind that many of these govern details of service that never or rarely come before the courts. A 50-p. index and a table of cases also filling 50 pp. provide easy reference to the mass of details which the volume contains. For the benefit of those who have no time to go through the detailed reviews, most of the chapters conclude with a brief summary. A general concluding summary is lacking. Instead the book closes with a miscellany of minor matters.

American Railway History

A SHORT HISTORY OF AMERICAN RAILWAYS, Covering Ten Decades—By Slason Thompson. Chicago: Bureau of Railway News & Statistics. Cloth; 6 x 9 in.; pp. 473; halftones and sketches; index. $2.

The writing of a history of the American railways that may be printed in one small volume and still cover the subject well is a difficult undertaking. That it can be done is shown by this book of Slason Thompson's, a man who has been in close touch with the railways of the country for many years. In less than 500 pages, little that is of importance in the history of the railroads has been omitted and much that gives the narrative life and interest has been included. Chief among the latter are the 400 illustrations which in their way tell the story of railroad development from the primitive structures and equipment of the early part of the 19th century up to the complicated and powerful equipment and extensive track layouts of the present day. Included among them are copies of many rare pictures of the early days of railroading. The illustrations have one fault—there are so many pictures of one make of locomotive as to make it appear as if the book were written for the benefit of its builders. Addendum A, which concerns the same make, adds to this impression.

The history frankly champions the railroad as is to be expected of anything written by Mr. Thompson, but it cannot be said that his championship is detrimental to the value of his work as a history because he has not glossed over those parts of the story which the railroad companies would willingly have forgotten.

The book treats of the history in ten decades, the earlier ones, naturally, given over to the picturesque story of construction and development, and the latter ones to the administrative side, rate regulation, federal operation, etc. The last chapter is given over entirely to personal sketches of prominent men in the railway field of the present day. Men who came on the scene earlier are treated in the story of the decade in which they became prominent. For both reference and good reading the book is well worth having.

The French Debt

THE FRENCH DEBT PROBLEM—By Harold G. Moulton and Cleona Lewis, with the aid of the Council and Staff of the Institute of Economics. [Institute of Economics: Investigations in International Economic Reconstruction.] New York: The Macmillan Co. Cloth; 5 x 7 in.; pp. 459; charts, appendices with tables, index. $2.

The Institute of Economics at Washington, which made the elaborate report on the Dawes plan, has now issued a book entitled "The French Debt Problem" in which it analyzes the financial situation in France and speculates on the best method of this country's attempt to collect the French debt. In view of the recent postponement of serious consideration of the debt, the book is of decided interest. The general conclusion of the authors is that the French financial system is strained almost beyond the elastic limit, that the possibilities of immediate industrial recovery in France are rather small, and the prospects for an early collection of the French debt by the United States highly vague.

Model Gasoline Tax Law

STATE GASOLINE TAXES—By Edmund P. Learned, A.B., A.M., Instructor in Economics and Commerce, University of Kansas. University of Kansas Humanistic Studies, Vol. III, No. 4. Lawrence, Kansas: University of Kansas. Paper; 6 x 9 in.; pp. 94. $1.

A model gasoline tax law has been compiled by Prof. E. P. Learned of the University of Kansas, Lawrence, Kan., from a summary and analysis of state gasoline tax laws printed in the volume named above. In his study an analysis is made of the arguments for and against gasoline taxes and a critical analysis of the present laws is undertaken. The pamphlet is well worth the attention of highway officials.

Geology for Technical Students

ELEMENTS OF GEOLOGY—By T. T. Quirke, E.M., Ph.D., Associate Professor of Geology and Chairman of the Department, University of Illinois, and Geologist (Temporary Employments), Geological Survey of Canada. New York: Henry Holt and Co. Cloth; 6 x 9 in.; pp. 414; 102 halftones, 45 line cuts. $3.50.

The relegation of historical geology to the rear and giving it only 40 pp. is a notable feature of this book. Even at that, the author assumes that the historical portion may not be used in the classroom but expresses the hope that students will read it, a hope which seems to be warranted by the interesting presentation.

Aside from the feature just mentioned the book should interest many of our readers because "it is an outgrowth of courses given by the writer during ten years at the State Universities of Minnesota and Illinois . . . . for students of engineering," with adaptation also to students of agriculture at Illinois. There is less attempt at direct engineering application in the volume than might be expected from the foregoing statement but the author says he thinks it wiser to leave engineering to engineers and soil physics to physicists. However this may be, it is certain that

every engineering student should be taught the elements of geology and that Professor Quirke's book does just this in an interesting way and with a minimum of dry bones and dusty rocks.

The book is in three parts: (1) The Earth; (2) Geologic Processes; (3) Historical Processes. It has illustrations that illustrate and its entire make-up is attractive.

British Booklet on Reinforced Concrete

ELEMENTARY GUIDE TO REINFORCED CONCRETE: Simple Explanation of Reinforced Concrete Design and Construction Specially Written for the Student, the Clerk of Works, Foreman and others Interested in Concrete—By Albert Lakeman, Chartered Architect, Licentiate R.I.B.A., M. Inst. Struct. E., Late Lecturer Woolwich Polytechnic. London: Concrete Publications Limited. Paper; 6 x 9 in.; pp. 69; 79 line cuts. 2 shillings.

The subtitle to this book describes it fully. Though written in the characteristic British style, which is not altogether intelligible to the average American workman, the exposition of the theory of reinforced concrete is very good and might reasonably prove useful to the students of elementary design.

PUBLICATIONS RECEIVED

A. S. T. M. Standards adopted in 1925 make up a 117-p. pamphlet. ($1.50, from American Society for Testing Materials, 1315 Spruce St., Philadelphia.)

THE PRICE of "The Seasoning and Preservation of Timber," reviewed in our issue of Sept. 17, p. 480, should have been given as $3.50 instead of $2.50.

FINANCIAL STATISTICS OF STATES, 1923, containing explanatory text, summary and detailed tables for the year named is now available. (20c. from Superintendent of Documents, Washington, D. C.)

ROAD CONDITIONS IN LATIN AMERICA are excellently summarized in a 165-p. report by Frank D. Curran of the U. S. Department of Commerce entitled "Motor Roads in Latin America." All interested in Latin American road building and especially the industries to which wider markets are opened by the development of highway transportation should find the book valuable.

CHARACTERISTICS OF SEWAGE-SPRINKLER NOZZLES details studies continued since 1922 from earlier investigations at Purdue University. The authors of the present bulletin, (Engineering Experiment Station, Purdue University, Lafayette, Ind.) are R. B. Wiley, F. W. Greve and M. T. Zucrow. A number of tables and diagrams are included. A more comprehensive summary of conclusions would have been helpful. An article by Mr. Zucrow based on the tests appeared in *Engineering News-Record*, Dec. 18, 1924, p. 999.

TIDES AND CURRENTS IN SAN FRANCISCO BAY is the second of a series of special publications giving "observations in the important waterways of the United States," issued by the U. S. Coast and Geodetic Survey, the first one having dealt with New York City. The authors of the present pamphlet are L. P. Disney, assistant mathematician, and W. H. Overshiner, lieutenant (j.g.) U. S. Coast and Geodetic Survey. The earliest observations noted were made in 1856. (20c. from Superintendent of Documents, Washington, D. C.)

FOR SUSTAINED INTEREST and for condensation of valuable material it would be hard to outdo the long series of annual reports on the Results of the Chemical and Bacteriological Examination of the London Waters, by Sir Alexander Houston, director of water examination, Metropolitan Water Board. The report for the year ending March 31, 1925, besides the usual tables and text summaries for the year, has 24 pp. on taste experiments, with special reference to the chlorination and the use of permanganate; 5 pp. on the Three-star Presumptive B. Coli test, an attempt at simplified procedure; 8 pp. on B. Welchii, Gastro-enteritis and Water Supply, a reprint, with additional comment of the author's contribution on this subject to *Engineering News-Record*, Sept. 22, 1921, p. 484; and 198 halftones, 1x¾ in., selected from moving-picture films exhibited to a group of visiting health officers from foreign countries. There is also a section on iodine and goiter and one on meteorology and health. (15 sh. from P. S. King & Son, Ltd., 2 Great Smith St., Westminster, England.)

THE PORTS OF Jacksonville, Fernandina, Miami, Key West, Tampa, and South Boca Grande, Fla., are described in Port Series No. 8, the twelfth volume of a fine series of reports upon the ports of this country being prepared by the Board of Engineers for Rivers and Harbors, War Department, in co-operation with the Bureau of Research, United States Shipping Board. Each volume contains excellent maps and airplane photographs of the ports described. The text gives general information in regard to port and harbor conditions, port customs and regulations, services and charges, fuel and supplies, and railroad and steamship lines and connections. ($1.10 from Superintendent of Documents, Government Printing Office, Washington, D. C.)

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

BATS, MOSQUITOES AND DOLLARS—By Charles A. R. Campbell. Boston, Mass.: The Stratford Co. Cloth; 6 x 8 in.; pp. 262; 39 full-page plates of halftones and line cuts; glossary, index. $3.

THE ECONOMICS OF PUBLIC UTILITIES: A Reference Book for Executives, Investors, Engineers and Students—By L. R. Nash, S. B., S. M., Public Utility Engineer, Stone & Webster, Inc., Sometime Lecturer at Massachusetts Institute of Technology, Harvard University and University Extension Division, Massachusetts Department of Education, Author of Sundry Monographs on Public Utility Problems and Development. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 430; 7 line cuts; list of Cases Cited. $4.

EVERYMAN'S INSURANCE: A Necessity for Home Protection —By Frazer Hood, Ph.D., Litt.D., Professor of Psychology in Davidson College. New York and London: D. Appleton and Company. Cloth; 5 x 7 in.; pp. 264. $1.50.

For the buyer of insurance—life, fire, marine, workmen's liability, and miscellaneous.

A GRADUATED COURSE IN STRENGTH AND RESISTANCE OF MATERIALS—By Edward Percy Coston, B. Sc., B. Eng. In Two Volumes. London: Scott, Greenwood & Son. American Distributor, D. Van Nostrand Co., New York City. Cloth; 5 x 8 in.; pp. 264 and 436; many line cuts, a few on plates; logarithmic and other tables. Price per volume, 10½ sh. in England, $4.25 in America.

A GRAPHIC TABLE COMBINING LOGARITHMS AND ANTILOGARITHMS—By Adrien Lacroix and Charles L. Ragot—Giving directly without interpolation the logarithms to five places of all five-place numbers, and the numbers to five places corresponding to all five-place logarithms; also a graphic table as above reading to four places. New York: The Macmillan Co. Cloth; 7 x 10 in.; pp. 64, including 46 pages of graphic charts. $1.40.

HYDRAULICS AND ITS APPLICATIONS—By A. H. Gibson, D. Sc., M. Inst. C. E., M. Inst. M.E., Beyer Professor of Engineering in the University of Manchester (England). Third Edition. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 801; 426 line cuts and halftones. $6.

This work has been brought to date, in the present third edition, by much rewriting. Because of the rapid development in the past ten years in the design of hydraulic prime movers, the section dealing with turbines has been recast, and a section has been added dealing with the wave transmission of energy in pipe lines. A chapter has also been added dealing with the principle of dynamical similarity and its applications to fluid motions and resistances, and the section dealing with the measurement of fluid flow has been largely extended. The first edition of the work was reviewed in *Engineering News*, Nov. 12, 1908, by Gardner S. Williams, and the slight changes that were made in the second edition were outlined in *Engineering News-Record*, March 16, 1922.

DIE STATIK DER BRÜCKENKRANE: Zahlenbeispiele zur statischen und analysischen Berechnung von fahrbaren Brückenkranen mit Hilfe der neuesten Methoden unter Verwendung von Einflusslinien—Von J. M. Bernhard, München, Germany. München und Berlin: R. Oldenbourg. Paper; 7 x 10 in.; pp. 51 plus plates; 20 line cuts, one table, 19 plates. 3.8 marks, gold, in Germany.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Why Water Mains Burst

Sir—The mention of bursting water mains and the discussion by Beekman C. Little in *Engineering News-Record*, Aug. 27, p. 341, need not occasion alarm, but it should recall the fact that the American Water Works Association has adopted factors of safety for cast-iron pipe 12 in. in diameter and upwards that range from more than 30 to less than 10, with a marked tendency toward lower factors for larger sizes. The association should correct its errors or enter a protest if the errors have been foisted upon it. The subject is not new. The facts have been recorded in its *Journal*. No like condition pertains to the factors of safety adopted by the New England Water Works Association.

H. F. DUNHAM.

New York City,
Sept. 15, 1925.

Concrete Practice Backward

Sir—The article by W. J. Barney on "What Is the Matter with Contracting" in your issue of Sept. 17, p. 456, is most interesting and should command the attention of all. Mr. Barney specifically states that his comments concern only "reinforced-concrete buildings mostly of industrial character such as factories, warehouses, etc." This comment is therefore in these same provinces.

Mr. Barney's indictments of the situation as it exists are forceful. He touches upon some very real and very vital matters. The force of his distinction between Class A, Class C, and Class D Contractors is not, however, fully evident as relating to this class of work or, in fact, any other class of concrete work, inasmuch as this classification seems to be a New York-ism rather than a designation recognized by the users in general of the 140-million-barrel annual cement output.

Putting aside questions of financial responsibility and the consequent orderly execution of work and the lack of trouble on the work, it further seems as though there were no real basis for this classification so far as the technical results achieved are concerned. It is unfortunately a fact that whether a Class A or a Class D contractor erects a building of concrete, this building will stand and fulfill its functions. Nor in the matter of endurance is there any difference noticeable to the writer between the buildings erected by one and the buildings erected by another. Both must use the same steel, the same cement, sand, stone, water and forms; and both put in their concrete by unskilled laborers.

The highly organized, financially responsible contractor, therefore, is directly in a position to be hammered down in his price, as stated by Mr. Barney, so long as the less organized man can get a bond. Mr. Barney's article, therefore, leaves the situation somewhat up in the air.

And it must remain up in the air so long as the standard for quality in concrete at the present time is physical strength at 28 days on a laboratory size test specimen, whether taken from the job mixer or made indoors. There is all the difference in the world between a chunk of concrete of this size, with its easy manipulation, and a cubic yard of concrete, or thousands of yards of concrete in forms.

So great is the energy of portland cement that strength sufficient for any usual purpose is difficult to prevent, rather than achieve. As a case in point, consider "cinder" arches. Much of the material used in this work might make a good fill; yet these floors stand, by grace of the steel hammock in which they are slung. The unhappy fact is that our standards of design are so low that almost any material can go into a structure of the type Mr. Barney specifies, and sustain the loads that will be placed upon it.

Engineers and architects no doubt are at fault in their specifications. But are they to be blamed for this? They are usually fulfilling the requirements of the art as commonly practiced; and the present state of this art puts a man with a dozen shovels and as many wheelbarrows on the same plane with a man who is splendidly equipped and who has full knowledge of what he is doing. If, however, specifications were properly drawn in the first place, with certain fundamental and necessary requirements which will absolutely insure quality, would not the situation be entirely changed? Under those conditions only the contractor who was able both in knowledge and in equipment to meet the specifications would be able to bid on the work.

NATHAN C. JOHNSON,
Consulting Engineer.

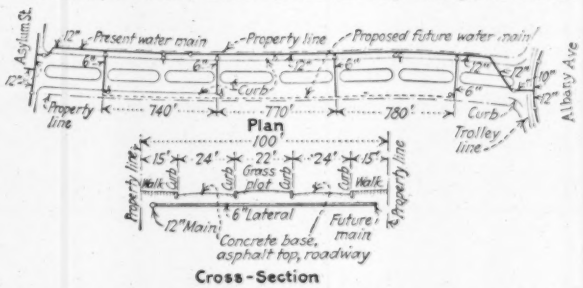
New York City,
Sept. 22, 1925.

Two Water Mains in Wide Streets

Sir—Supplementary to my remarks on two water mains on wide streets, published in your issue of Aug. 27, p. 333, I send the following account of what has come about in this respect in Hartford to meet conditions as they have arisen rather than because of a fixed plan—although the advantages of two mains have become so obvious that we expect to put in two mains on wide streets in the future. I also give, in conclusion, a summary of our practice as to materials for service connection, which are laid by the Water Department, and a table of our charges for tapping the main and for maintenance.

One of the older main streets of the city had a 6-in. pipe laid on the south side of the street for a long distance. At a later time a 30-in. supply main was run through this same street, but on the other side of the roadway. Thereafter connections on either side were taken off from the main on that side. The older 6-in. pipe was a cement-lined pipe, and, therefore, of rather doubtful value. Several years ago it became desirable to pave this street with concrete, and as it did not seem well to leave the old cement pipe under the pavement, a new cast-iron pipe of the same size was laid under the southerly sidewalk to take the place of the cement-lined pipe, this pipe being cross-connected with the 30-in. main at nearly every block.

In another street, where there was a public park extending the whole distance on one side of the street, the water main was placed in the sidewalk space. This sidewalk was about 10 ft. wide, with a 4-ft. granolithic walk in the center and a grass plot on either side, the water main being placed in the grass plot between the edge of the walk and the property line, thus making house connections of minimum length.



SCHEME FOR INSTALLING SECOND WATER MAIN IN A WIDE STREET AT HARTFORD, CONN.

In another case, on account of the demand for supplying water to isolated houses along a distance of perhaps two miles and a considerable settlement at the end, an 8-in. main tapering to a 6-in. at the further end has been laid on one side of the street, which is a state trunk highway. Within the next decade undoubtedly this part of the city will be fully developed and a larger main will be necessary. It is planned to put a 12-in. or perhaps a 16-in. main on the opposite side of the street when the demand becomes insistent, rather than to lay a larger main at the present time into this territory with the idea of foreseeing future demands. This method will allow a minimum of service pipes crossing this highway at the present time, and will avoid this nuisance altogether when the section becomes built up.

In a case where a 30-in. main feed line ran for several miles through undeveloped territory, an 80-ft. boulevard

has recently been laid out over this pipe line, and a high class of development is now under way. For quite a long distance this street is being surfaced with a pavement which it is desirable hereafter to disturb as little as possible because it is really a through route which will probably be greatly traveled in the future. An order has been issued that this 30-in. main shall not be tapped for service connections. To supply the houses which are being built, it is planned to run at each block on each side of the street an 8-in. lateral to the side lines and there connect these with a 4-in. pipe, or perhaps a smaller one, laid under the sidewalk for the supply to the houses. Fire protection will be taken care of by hydrants placed at the street intersections.

In a case that has arisen since my first communication, the present (12-in.) water main was laid a number of years ago on the westerly side of the street with the intention of putting a duplicate main on the easterly side, when the street is more fully developed, the 12-in. pipe being laid as a feeder main to the north, there being practically no property developed on this street. Within the last few years, however, the street is being rapidly built up, and it is now necessary to furnish water on the easterly side and at the same time both roadways are to have a concrete base with an asphalt top, which it is desired to avoid cutting into as much as possible. The accompanying sketch shows how this case is being handled.

Hartford does not lay service pipes in advance of pavements and in my opinion it is not practical. Ten or fifteen years ago, due to the popular cry for installing such connections in streets which were to be expensively improved, service connections were laid from the main to the street line, the lots being laid out but no houses or buildings having been built at that time. These were ordinary ¾-in. service connections. Since that time one of these streets has become a commercial street, and instead of dwelling houses being built, some storehouses and business blocks have been erected, thereby requiring the installation of larger pipes both for water service and fire protection. The services which had been previously installed were, therefore, of no value. Every little while a leak developed at one of them, and it was necessary to cut into the pavement, remove the service, and plug the hole in the main. In another street, a residential one, when the houses were located and the plumbing installed, either no attention was paid by the architects to the previously-installed service pipe, or else the character of the buildings was such that the existing services could not be used. New service pipes were installed in their place in many cases because of the larger pipe needed for modern conditions of plumbing.

Another argument against the installation of services too long a time in advance of when they may be used, is found in the materials which present good practice advocates as against those previously considered proper. For instance, ten years ago steel pipes were used for service connections to a considerable extent. These pipes buried in the ground without use for ten years would hardly be of use at the present time. The tendency now is to use those of more permanent characteristics, and it is possible that even better materials may be used in the future.

All services now installed, up to and including 2-in. size, are genuine wrought-iron, cement-lined; or brass, if the applicant prefers to pay the difference in cost. Our 1-in. cement-lined pipe at our shops costs about 25c. per foot, while I am informed that brass pipe of this size costs something over double. Above the 2-in. size, services are of cast iron, and wherever a cast-iron 2-in. pipe can be laid to advantage, that is done. From the property line to the building the service pipe is laid by the property owner at his own expense. The work, however, is inspected by the water department and it must approve the material used.

The lot frontages in our residential sections will generally average from 40 to 75 ft. The Hartford Water Department makes the following charges for connections:

Size, In.	In Improved Pavement	In Other Locations
1	$75	$45
1¼	90	60
2	105	75
4	280	250
6	360	330

This includes tapping the main, laying the service pipe from the main to the street line, and maintaining the service thereafter. This is a connection charge and not payment for the work, although the amount is based on what has been found to be the average cost. The city claims title to these service connections, and they are carried as a part of our plant value, being charged to capital account.

CALEB MILLS SAVILLE,
Manager and Chief Engineer Water Board.
Hartford, Conn., Sept. 25.

"Measuring Sewage Flow by Pitometer"

Sir—My article "Measurement of Sewage Flow by Pitometer" appearing in *Engineering News-Record*, Sept. 24, p. 518, should perhaps be enlarged upon by a word of warning against the possible danger of pollution due to back flow of sewage into the water mains in the event of temporary failure of pressure in the latter, or momentary building up of pressure in the former.

In this particular instance the city pressure was so high and the pressure in the sewage force main so low that there was practically no change in back flow, but as a general proposition it is hazardous to make a direct connection between any source of pollution and a public water supply, and the method outlined in my article should not be practiced "in toto" unless the operators are fully aware of the potential danger and can be trusted to guard against it. In fact, it might be preferable to avoid the direct connection in any event when the pressure supply is from mains used for drinking purposes, substituting a tub or pail from which flushing water could be forced by a hand pressure pump. In some cases a pneumatic pressure tank and power pump could perhaps be used.

ARTHUR L. SHAW,
Boston, Mass. Metcalf & Eddy, Consulting Engineers.
Oct. 3, 1925.

Broadening the Engineering Student

Sir—Helpful comments on engineering by periodicals are comparatively rare. I wish to express my appreciation and approval of your editorial on "How to Humanize the Engineering School" in your issue of Sept. 3. Criticisms of engineering education seem to occur in waves and one of the recent evidences was the more or less general demand that students be taught the fundamentals, on which your comments are excellent. Another wave carried on its crest a demand for instruction in accounting and business methodds. To the purpose no one could object and it undoubtedly had its influence on engineering schools.

Another crying need is for potential executives and more or less urge has been expressed that the engineering schools should supply the need.

Human engineering has been emphasized for several years for the purpose of encouraging instruction in safety, welfare and management in order that a certain proportion of young engineers might take their places in industry if fitted for it. There is another side to human engineering also of importance in education. The young engineer has not been encouraged to interest himself in human affairs until very recently. How rarely have engineering societies urged public policies such as the reorganization of departments at Washington for better management and co-ordination. The engineer has confined himself as an individual and in societies to those matters which were largely of individual or professional value as you say in the editorial.

In the process of education it is important that the young engineering student be encouraged to consider his relations and obligations to society as well as to consider his technical responsibilities. There are various methods of giving students the broader point of view. To a considerable extent it depends upon the breadth of the engineering faculty. In addition to formal instruction, many engineering schools invite speakers from larger industries and from private practice to speak to the students. It is important that speakers should give more attentior to these broader aspects rather than to technical ones. I think the colleges are quite able to give the technical point of view and give it adequately.

Industry should feel its responsibility for a part in technical education and it can meet that part if its high officials who have a broad grasp of engineering management and life will take an interest in engineering education and assist in giving the young student breadth and a correct perspective of engineering.

R. L. SACKETT,
Dean of Engineering, Pennsylvania State College.
State College, Pa., Sept. 9, 1925.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

International Toll Bridge Planned for Detroit

Highway Bridge Over Detroit River Actively Promoted—Cities to Help Finance

Active discussion of a large highway bridge across the Detroit River at Detroit has been in progress for some time. The project is being promoted by J. A. Bower, vice-president of the New York Trust Co., New York. It is a new development of the American Transit Co. project promoted by Chas. E. Fowler four years ago (*Engineering News-Record*, Sept. 29, 1921, p. 524), and proposes to make use of the franchises and governmental permits obtained by that company at the time, and to utilize approximately the same location selected by Mr. Fowler.

In a local statement the representatives of the new project described the proposed location of the bridge as near Huron Line Road in the town of Sandwich on the Canadian side, and somewhere between 16th St. and West Grand Boulevard on the Detroit side. This would place the bridge about 1½ miles west of Woodward Ave., the central axis of the city. The structure to be built, according to plans and estimates prepared by the McClintic-Marshall Co., of Pitsburgh, is a suspension bridge of about 1,850 ft. span and 110 ft. clearance height above river level, carrying a single deck giving a 47-ft. vehicle roadway. No railway or street-car facilities are to be provided on the bridge. The entire length of structure between entrances would be nearly 7,000 ft. The estimated cost is in excess of $12,000,000.

Financial Plans

In order to finance the enterprise, interests connected with the promoters offer to take all the stock, of which it is intended to issue $1,000,000; to retire the outstanding stock and obligations of the American Transit Co.; to cover $5,000,000 of the cost by debentures guaranteed by the Canadian border cities and the provincial or Dominion government; and to issue $6,000,000 of general bridge bonds. The bonds and debentures would have first claim on the bridge revenue. As traffic estimates indicate that the revenues are ample to cover all charges even at large reduction over present ferry rates, the soundness of the enterprise is held to be assured, and the further guarantee of a large part of the indebtedness by the Canadian municipalities is expected to place the financial standing of the bonds beyond question.

Arrangements have been made between the promoters and the McClintic-Marshall Co. for the latter to undertake the construction, complete, for a definite sum, under guarantee.

At the present time the project awaits referendum votes of the Canadian municipalities on the proposed guarantee of the bridge debentures. This, with other final steps in the organization of the undertaking, is expected to require until early spring, permitting construction to begin next season.

Engineering Fifty Years Ago

From *Engineering News*, October, 1875

THERE is very little business in Chicago just now for surveyors and engineers. Occasional surveys are needed, but the sum total of all the work would not more than support one office. There are, therefore, no vacant situations in this city for surveyors or civil engineers, and it is only a waste of money and time to come here after one.

THE anchorage of the East River bridge (New York) is completed. Cable-making for the bridge will commence at once.

Topics for Baldwin Prize in 1926

Competitors for the William H. Baldwin prize to be awarded in 1926 have a choice of the three following topics: Bonds vs. Pay-as-You-Go-Plan for Financing Permanent Improvements; Application and Administration of Special Assessments; Administration of Local Health Service. The prize is offered yearly to undergraduate students of any college or university in the United States providing direct instruction in municipal government. Essays not over 10,000 words in length must be mailed to the National Municipal League, 261 Broadway, New York City, not later than May 15, 1926. Further details may be had from the League on application. The 1925 prize was awarded to Morris Ploscowe of Harvard University for his essay entitled "Informing the Citizens About the Government."

Another High Rock-Fill Dam Planned in the West

A license for a power development on the North Fork of the Mokelumne River in California has been granted to J. W. Preston, Jr., of San Francisco. The project includes a rock-fill dam approximately 200 ft. high and 960 ft. long and 25 miles of conduit made in part of open ditch, flume and tunnel. The power plant will develop a static head of 1,247 ft. in two double overhung impulse wheels of 10,500 hp. capacity each.

New Committees for Civil Engineers Approved

Board of Direction Provides for New Divisions and Committees—Medals Awarded

Many constructive proposals looking to increasing the value of the society to its members were acted upon by the Board of Direction of the Am. Soc. C. E. at its Fall meeting held in Montreal Oct. 12 and 13. A number of these were based upon the several recommendations embodied in the progress report of the Committee on Aims and Activities submitted at this meeting. Among the more important were those looking toward the strengthening of the technical divisions in order that they may stimulate and guide the technical activities of the society and those designed to make the action of the society more effective in the handling of matters of professional conduct.

An application for the formation of a construction division was approved by the board as was a recommendation in favor of a division of consulting engineers. Several recommendations by the Committee on Aims and Activities relating to publications and meetings were referred to the Committee on Technical Activities and Publications for consideration and report to the board.

The board approved a policy of formally approving on behalf of the society such standard specifications and other documents as may be recommended by the technical divisions and special committees of the society.

The establishment of a standing committee on fees and salaries was approved. It is to be charged with the duty of keeping in touch with prevailing rates of compensation and of being prepared to make appropriate recommendations to the Board of Direction or the Executive Committee in specific cases that may arise. Several recommendations by the Committee on Aims and Activities designed to make it more attractive for the young engineering graduate to join the society soon after his graduation were approved.

Medals Awarded

The Norman Medal was awarded to Harrison P. Eddy for his paper entitled "Imhoff Tanks—Reasons for Differences in Behavior," the James R. Croes Medal to Charles S. Whitney for paper on "Design of Symmetrical Concrete Arches," the Thomas Fitch Rowland Prize to H. de B. Parsons for paper on "Sherman Island Dam and Power House," the James Laurie Prize to William Kelly for paper on "The Colorado River Problem," the Arthur M. Wellington Prize to William M. Black

(*Continued on p. 649*)

for paper on "Waterway and Railway Equivalents."

Action was taken by the board in accordance with constitutional procedure looking toward the investigation of charges against three members of the society as to unprofessional conduct, and on the recommendation of the committee on professional conduct the board adopted rulings in the matter of engineers called in to review the work of other engineers and architects, and with respect to the acceptance by engineers of commissions from manufacturers. A ruling was adopted also defining appropriate advertising practice for professional engineers.

The board approved the continuance of the society committee on the city plan of Washington, D. C., and authorized it to co-operate with other agencies engaged in this movement.

A redistricting plan affecting particularly the territory west of the Mississippi River was adopted pending comment from the various local sections interested. In the matter of the proposed inventory of the water resources of the United States by the U. S. Geological Survey the board expressed its approval of the plan and urged its support.

Suburban Terminal at Long Island City Proposed

The construction of a passenger terminal over the Sunnyside yards in Long Island City for the use of passengers from the New Haven, New York, Westchester & Boston, and the Long Island railroads was proposed by LeRoy T. Harkness, a member of the New York State Transit Commission, at a hearing of the New York State Suburban Passenger Transit Commission on Sept. 30. The proposed terminal would be over the tracks of the Long Island R.R. where they approach the tunnels extending to the Pennsylvania terminal in New York City. Suburban passenger trains from the New Haven and the New York, Westchester & Boston, would come into the new terminal by the Hell Gate bridge route.

The terminal is proposed in order to relieve congestion at the Pennsylvania and the Grand Central Terminals on Manhattan Island by making direct connections with the Interborough and the Brooklyn-Manhattan transit systems on Manhattan Island from the new terminal in Long Island City through the 60th St. and the 42nd St. rapid transit tunnels under the East River.

Traffic Problem Study Planned by Engineering Council

A survey of traffic problems in the United States is planned by the American Engineering Council through the medium of the national and local engineering societies. The council has appointed a general committee and has named W. B. Powell as chairman. Under the proposed plan, the local societies will make reports on specific problems and will submit them to the general committee.

New Railroad Across Pennsylvania Opposed by Experts

Experts of the Interstate Commerce Commission who have been examining the application of the New York, Pittsburgh and Chicago Air Line Railroad Co. for authority to construct a new railroad line across Pennsylvania from Pittsburgh to Easton, have recommended to the commission that the application of the railroad company be denied but without prejudice to its resubmission. The proposed railroad is 283 miles long and forms an essential link in the trunk line railroad system from New York to Chicago, proposed by L. F. Loree, president of the Delaware & Hudson Co. It is backed by the estate of the late E. H. Harriman who became interested in the project many years ago. A description of the line was given in our issue of June 25, 1925, p. 1076.

Extension Granted on Completion of Cushman Project Dam

The City of Tacoma has granted A. Guthrie & Co., the contractors who are erecting the dam at Lake Cushman on the city's hydroelectric power development project, an extension of time in which to complete the structure. The completion date, which was set originally at Sept. 15, has been advanced to Dec. 1, 1925.

Last Section of Welland Canal Put Under Contract

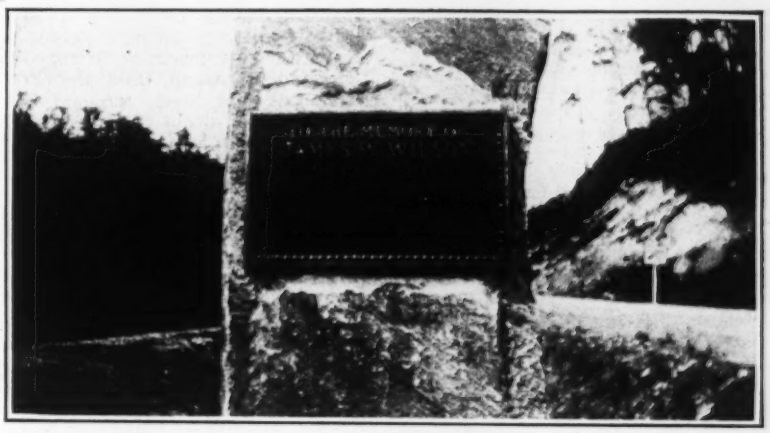
The Canadian Government has awarded the contract for the last section of the Welland Canal, Section 6, to a combine formed by E. O. Lahey & Co. and the Atlas Construction Co. for an amount slightly in excess of $7,000,000. The section of canal under this contract is from Welland to Port Robinson. It is expected that work will be commenced during the coming winter.

Construction Council to Meet at Chicago in November

The fourth annual meeting of the American Construction Council will be held at the Congress Hotel, Chicago, Ill., Nov. 18 to 21. Features of the meeting will be a conference on better building and a general section on the reduction of construction peaks and depressions which will include a report of the joint committee of the council and the American Railway Association on the co-ordination of publicity for a country-wide campaign on greater stabilization of construction. Highway construction will be considered at the session on Saturday, Nov. 21.

Regional committees of the council are being formed in leading construction areas of the country to bring together the various branches of industry to handle questions of common concern.

Tablet Set Up in Honor of Former Chief Engineer of Southern Ry.



TABLET IN MEMORY OF JAMES W. WILSON

A tablet to honor the memory of James W. Wilson, formerly chief engineer of the Western North Carolina Railroad Co., now part of the Southern Railway System, has been set up by the Southern Ry. near Old Fort in the Blue Ridge Mountains of North Carolina, near the point where Major Wilson lived while supervising the construction of the line by which that railway still crosses the Blue Ridge Mountains. The tablet reads: "To the memory of James W. Wilson—1832-1910—who as chief engineer and president of the Western North Carolina R.R. planned, supervised and built this line across the Blue Ridge Mountains. Erected by the Southern Ry. as a tribute to a master builder."

The railroad had been completed from Salisbury to Old Fort in 1869, where it was stopped by financial difficulties and the obstacle presented by the 1,092-ft. rise between Old Fort and Ridgecrest, 891 ft. of which lay between two points only 3.4 miles apart. After a checkered career, the railroad passed to the control of the State of North Carolina. Work on the extension across the mountains was begun in 1877 under Major Wilson's direction and was completed in December, 1879. The satisfactory nature of Major Wilson's work is indicated by the fact that although the bridges and roadbed have been entirely rebuilt since that date, the railroad still follows the original alignment.

No Bids Submitted on Portland's $2,000,000 Project

On Sept. 30, bids were to have been opened for the purpose of making awards of contracts on the first $2,000,000 unit of the sea-wall, intercepting sewer, and pumping plant to be constructed by the city of Portland, Ore., but when the time came to open the bids it was found that not a single bid had been submitted, although twenty-seven sets of plans and specifications had been taken out by contractors from all parts of the Northwest. This dearth of bids is laid to the fact that a suit for injunction is now pending against the city in connection with the project. Until the case is decided, no further effort will be made by the city to obtain bids.

The suit is set for hearing by the Circuit Court on Oct. 26, and should the outcome be favorable toward the city, a new call for bids will be made at once.

Chicago Regional Plan Body Lays Basis for Wider Roads

A special survey of the traffic obstacles existing on the main thoroughfares within the region of Chicago has been undertaken by the Chicago Regional Planning Association. The survey now under way with the co-operation of the Chicago Motor Club has for its immediate objective the improvement of the inefficient and dangerous sections of the most heavily traveled roads. Studies by the committee on highways of the association, indicate that sharp angles and curves, poor stretches of pavement, unpaved car tracks in municipalities, narrow subways or bridges and grade crossings are the principal causes of traffic tangles which affect long lines of motor cars on the unobstructed pavement. These obstacles to free-flowing traffic can be ironed out by the co-operation of the various responsible authorities.

Western Ave., the Dixie Highway route from Chicago to Momence, was selected for first consideration because it is the principal outlet south from the city and, according to the traffic survey conducted last year by Cook County in conjunction with the U. S. Bureau of Public Roads, carries almost 16,000 vehicles daily and over double that number on Sundays, the greatest volume of traffic of any of the city's outlets.

The present survey supplements the data now on hand in county and state highway offices and includes a detailed map and report on the width of crossings and suggestions for their improvement or removal, directness of route, marking, subways, viaducts and bridges and the width, type and character of street pavements in cities and villages through which the route passes.

The study is not only ferreting out traffic obstacles and working out means to eliminate them but is also furnishing the basis for detailed plans now under consideration by the association for a system of broad radial and circuit highways. From the Dunes Highway on the east to Sheridan Road on the north including every main radial highway of the Chicago region there is need for wider pavement, elimination of bottle-necks and improvement of dangerous turns and crossings. Federal, state, county and municipal officials, who constitute the regional committee on highways, have planned this survey as a major step toward providing adequately for the traffic on the highways in the Chicago region which, it is predicted, will double in the next five years.

Howard R. Olson, formerly with the Iowa State Highway Commission has been employed to handle the survey under the general direction of Robert Kingery, secretary of the association.

General Contractors to Meet at Portland in 1926

The executive board of the Associated General Contractors of America, in session at Dallas, Texas, selected Portland, Ore., as the convention city for January, 1926. The nominating committee, in its report, named J. H. Ellison of Minneapolis the next president and N. McDougall, of Portland, Ore., as vice president.

Construction of Test Dam Begun

Foundation excavation for the Stevenson Creek test dam of the Engineering Foundation experimental arch dam investigation has been begun, according to announcement by the Foundation. It is now expected that placing of concrete and setting of many of the instruments will be done in December of this year. December being the month of minimum temperature and least temperature variation, it offers the best opportunity for constructing a dam free from cracks. It is also announced that W. A. Slater, of the Bureau of Standards and formerly of the University of Illinois, has been engaged to take charge of the experimental work on this dam.

A.S.T.M. Committees to Meet in Cleveland

Following the practice initiated last year, a number of the committees of the American Society for Testing Materials will hold meetings during the three-day session for such meetings, at the Hotel Cleveland, Cleveland, Ohio, Oct. 27-29. Committees on steel, wrought iron, alloys, cement, drain tile, refractories, gypsum, coal and coke, electric insulating materials, rubber products, and some joint committees are scheduled for the meeting.

Operation of Stone Quarry Enjoined

The New York State Court of Appeals on October 7 affirmed the judgment of the Appellate Division of the Supreme Court enjoining the operation of the marble quarry of the Tuckahoe Stone Corporation of Eastchester as a violation of a local zoning ordinance, adopted October 15, 1923.

Random Lines

Fair Enough

"A crew of workmen directed by a corps of expert engineers is constructing a bridge across Diamond Canyon" —San Francisco *Examiner*.

One expert engineer to each workman, we suppose.

* * *

The Void Theory Made Practical

"A reader asks us," says the *Rural New Yorker* editorially, "to tell him what we know about 'aerated concrete,' said to be made by blowing a strong current of air up through the concrete mixer. We have not been able to find anyone who knows anything about it."

* * *

Fit Punishment

"A few days after the Bronx Parkway was opened," says the Hartsdale *Herald*, "a motorist from New York City with a feminine companion was regaling her with chocolate creams. As they munched and gazed they threw out paper wrappings on the parkway. From Butler's Woods, above Scarsdale, to Woodland Place Viaduct, in White Plains they fed their eyes and their palates. Then Officer Frank MacCabe of the parkway police shot up beside them and asked them if they were enjoying themselves. When they admitted that they were, he said that it was the intention of the parkway authorities that all others should be similarly privileged; and he made the young man walk back four miles and pick up all the papers, personally conducting him on his motorcycle."

* * *

Seeing Things at Night

The Canadian obsession regarding the essential criminality of the Chicago drainage canal diversion reached its height the other night when a member of the Royal Astronomical Society at a meeting at the University of Toronto tried to make out that taking the water away from that section of this terrestial globe where it has always been would sooner or later result in a geophysical unbalance with the direct consequences to all who have rather counted on the earth keeping fairly close to its established position and behavior for some time. Unfortunately for this inquisitor the chairman of the meeting was an eminent and practical professor of astronomy who could not see how the 8,000-mile globe could be much disturbed by a foot or so of displaced water surface. The professor even went so far as to utter the heresy that possibly deficient rainfall had something to do with the lowered level of the Great Lakes. All this, however, did not prevent the Toronto *Globe* from featuring the incident in a story which starts out "Chicago's water steal found its reflection at a gathering, etc., etc." The punch, as all good journalists know, lies in the opening sentence of a story.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Fall Meeting, Montreal, Que., Canada, Oct. 14-16, 1925.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York City; Annual Convention, St. Louis, Mo., Oct. 19-22, 1925.

AMERICAN RAILWAY BRIDGE & BUILDING ASSOCIATION, Chicago, Ill.; Annual Convention, Buffalo, N. Y., Oct. 20-22, 1925.

ASPHALT ASSOCIATION, New York City; Annual Paving Conference, Detroit, Mich., Oct. 21-23, 1925.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, Lakeland, Fla.; Annual Meeting, Des Moines, Iowa, Oct. 26-30, 1925.

CITY MANAGERS ASSOCIATION, Lawrence, Kansas; Annual Convention, Grand Rapids, Mich., Nov. 17-19, 1925.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington, D. C.; Annual Convention, Detroit, Mich., Nov. 18-20, 1925.

HIGHWAY RESEARCH BOARD, Washington, D. C., Annual Meeting of the Highway Research Board, Washington, D. C., Dec. 3-4, 1925.

The Iowa Section, American Water-Works Association, will hold its 11th annual meeting Dec. 2-4, 1925, at Dubuque, Iowa. Jack J. Hinman, Jr., of Iowa City, Iowa, is secretary of the section.

Personal Notes

MAJ.-GEN. WILLIAM M. BLACK, retired, former Chief of Engineers, U. S. Army, has been retained by the Chicago Port Commission to outline, the necessary steps to formulate a municipal harbor policy. COL. A. A. SPRAGUE, commissioner of public works heads the Port Commission and COL. HENRY A. ALLEN is the engineer. A practical program of harbor development is necessary before the War Department will approve the erection of certain bridges desired over the Chicago River at La Salle St. and at the mouth of the river.

EDWARD S. CLARK, city engineer, Kalamazoo, Mich., has been appointed acting city manager to fill the position left vacant by the resignation of CLARENCE L. MILLER, effective Oct. 1. Mr. Clark will hold both positions pending the appointment of Mr. Miller's successor early in November.

WILLIAM T. BLUNT, recently retired from his position of assistant engineer, U. S. Engineers Office, Chicago, has been made staff engineer for the D. P. Davis Properties, Tampa, Fla., in charge of the company's developments in St. Augustine. Mr. Blunt is a graduate of Massachusetts Institute of Technology in 1874 and has served the government for 35 years being in the Chicago office for the last eleven years, on Lake Erie on lighthouse and harbor work for seventeen years, at Panama in charge of subaqueous rock excavation for three years and on the first Mississippi River Commission for four years. He built most of the range lights on the Detroit River.

W. E. MORAN has been appointed engineer of the fire protection for the Cleveland, Cincinnati, Chicago & St. Louis Ry., with offices at Cincinnati, Ohio. He succeeds E. N. Floyd, who has resigned.

HENRY L. CONNELL has been appointed a member of the new Board of Standards and Appeals, New York City, and is the structural engineer member of the board. This board is a consolidation of two previous boards with the total membership reduced from 13 to 5.

FRED D. EMERSON, city engineer of Batavia, N. Y., has resigned and will become New York state representative for the Badger Gummed Tape Co., Racine, Wis., with headquarters at Lockport, N. Y.

H. R. O'MARA, city engineer of Mt. Clemens, Mich., has resigned.

HIRAM HEAD of Crocker, Mo., has been appointed surveyor for Pulaski County, Missouri. He succeeds W. M. MITCHELL, resigned.

H. C. FRAHM, engineer of the Minot district of the State Highway Department of North Dakota, has been appointed chief engineer of the State Highway Department to succeed W. G. BLACK, whose resignation became effective on Sept. 15. Mr. Frahm is a native of Rochester, Minn., and a graduate of the University of Minnesota in the class of 1908. He began highway work in Ward County, N. D., in 1917, became resident engineer in 1918 and division engineer in 1922.

H. F. WEIDEMAN, of Atlanta, Ga., has been appointed to take charge of the details of the unfinished engineering work in connection with the improvement of the Atlanta water-works to succeed the late Paul Norcross. J. N. ELEY has been appointed to take over the work in connection with the new pumping station, work in which he was associated with Mr. Norcross.

JOHN W. LOWELL, assistant manager service bureau, Universal Portland Cement Co. and with which he has been associated for 14 years, has resigned to become vice-president of Benedict Stone, Incorporated, of Chicago, makers of manufactured stone. The company is affiliated with Benedict Stone Corporation of New York and Canadian Benedict Stone, Ltd., of Montreal. Mr. Lowell is a graduate in civil engineering from the University of Wisconsin. With the cement company he has been involved mainly in research, particularly in the manufacture of concrete products.

Obituary

THEODORE LOW, prominently connected with the Norfolk & Western Ry., since 1888, died at Roanoke, Va., Sept. 13, 1925. Mr. Low was born at Pittsburgh, Pa., Dec. 11, 1862. His first engineering experience was with the Baltimore & Ohio R.R., Pittsburgh, West Youngstown-Chicago line. Following this he was on the Pittsburgh, McKeesport & Youghiogheny R.R. subway work on the south side at Pittsburgh, Pa., and then on location and construction of the Schuylkill Valley Division of the Pennsylvania R.R. near Pottsville, Pa. In 1886 he succeeded Samuel Rea on the West Penn Division of the Pennsylvania. In 1888 he entered the service of the Norfolk & Western Ry. as engineer maintenance-of-way of the Shenandoah Division, and subsequently in the same capacity on the Eastern Division. Following this period, he became superintendent of the Lynchburg and Durham and the Norfolk divisions. From 1902 until the time of his retirement he was real estate agent for the Norfolk & Western. Mr. Low was a younger brother of Emile Low, who also for a time held various engineering positions on the Norfolk & Western Ry. and is now assistant engineer, retired, War Dept. U. S. Government.

PETER B. WIGHT, one of the pioneer architects of Chicago, and long connected with professional activities in that city, died at his home in Pasadina, Calif., on Sept. 8, at the age of 87 years. Mr. Wight was for many years secretary of the American Institute of Architects, to which society he was elected a fellow in 1866. His name is on the first page of the first issue of *Engineering News*, published in April, 1874, as vice-president of the Chicago Chapter of the Institute. For years he was on the board which licensed structural engineers and architects in Illinois.

WILLIAM C. BRADBURY, aged 76, one of the contracting engineers who helped to build many railroads in the Rocky Mountain regions, giving some of the communities their first railroad, died at Denver, Col., Oct. 4, 1925. Mr. Bradbury was a native of Taunton, Mass., and went to Denver in 1871.

W. H. SCRIVEN, superintendent of the Western region of the Pennsylvania Railroad System at Chicago, was killed near Carbondale, Ind., in an automobile accident on Oct. 3. Mr. Scriven, who was 58 years old, began work for the Pennsylvania as a rodman.

JAMES W. NAUGHTON, for 25 years a sanitary engineer with the Board of Health of New York City, died at his home at Forest Hills Gardens, Long Island, Oct. 6. Since 1917 Mr. Naughton had been serving on the Joint Board of Sanitary Control of New York City.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Concrete Road Yardage

For September the square yardages included in concrete pavement contract awards according to the Portland Cement Association were: 4,087,442 for roads; 5,018,902 for streets; and 624,006 for alleys; or a total for the month of 9,730,350 sq.yd.

The accompanying table summarizes the statistics for the current year:

SQUARE YARDS OF CONCRETE PAVEMENT AWARDED DURING 1925

Month	Roads	Streets	Alleys	Total All Classes
Jan.	3,474,421	963,256	75,236	4,512,913
Feb.	3,787,192	1,201,224	58,723	5,047,139
March	5,728,862	2,483,662	190,553	8,403,077
April	12,462,646	4,431,220	469,117	17,362,983
May	7,724,075	4,169,707	392,656	12,286,438
June	5,980,857	3,904,733	335,981	10,221,571
July	6,361,686	5,147,203	535,156	12,044,045
Aug.	6,368,201	2,973,301	252,341	9,593,843
Sept.	4,087,442	5,018,902	624,006	9,730,350
Total.	55,975,382	30,293,208	2,933,769	89,202,359

Business Notes

L. S. PEREGOY, secretary, Sivyer Steel Casting Co., Milwaukee, Wis., has recently been elected second vice-president of the company. He succeeds Donald Fraser, formerly vice-president and works manager of the Chain Belt Co., who has not been active for some time. Sivyer Steel Casting Co. is affiliated with the Chain Belt. Co. of Milwaukee.

ROAD BUILDERS' EQUIPMENT CO., Portland, Oregon, announces a change in name to the J. L. Latture Equipment Co. The change was necessitated by confusion of the old firm name with other firms of somewhat similar name. There will be no change in the personnel.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa., announces that its El Paso and Phoenix offices have been consolidated under the direction of E. D. Stewart, branch manager of the El Paso office. W. G. Wilson has been appointed local manager at Phoenix and will report to Mr. Stewart at El Paso. J. H. Knost, formerly branch manager of the Phoenix office, has been appointed industrial and power sales engineer for the entire Los Angeles district.

FEDERAL CEMENT TILE CO., Chicago, has established a new branch sales office at Indianapolis, Ind., under the direction of C. B. Baird, who has for many years been affiliated with the company in various capacities.

PERCY OWEN, former chief of the Automotive Division, Department of Commerce, has resigned to join Dodge Brothers, Inc., Detroit, as director of foreign sales.

CHAIN BELT CO., Milwaukee, Wis., has appointed the Burress-Clark Company as its Florida West Coast representative with offices in Tampa, Fla.

Equipment and Materials

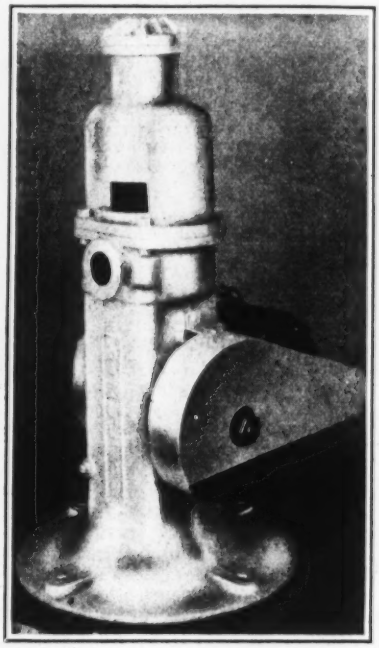
Power Head Totally Inclosed on Deep Well Pump

A new line of deep well pumps recommended for heads up to 600 ft. and able to discharge about 250 g.p.m., having their power heads completely inclosed, is manufactured by the American Well Works, Aurora, Ill. The main frame totally surrounds all the gears and all of the main bearings run in a bath of oil, a feature which is claimed to make the operation of the pump practically noiseless. These heads are made for both 6- and 12-in. strokes for operation with single stroke cylinders. The displacement cylinder is the same diameter as the lower cylinder, which permits the removal of the plunger rod and plunger without breaking either the suction or discharge connection. The equipment is furnished either with

a drive pulley for motor drive or a tight and loose pulley for gasoline engine operation. The T-head at the bottom is tapped for a maximum size drop pipe of 4½ in. and a maximum discharge pipe of 2½ in. The horsepower varies from ¾ to 5, depending upon the head and required discharge.

Small Vacuum Pump for Priming Centrifugal Pumps

A small-sized vacuum pump of the dry type has been added to the line of priming pumps manufactured by Barrett, Haentjens & Co., Hazleton Pa. It is claimed that the users of centrifugal pumps are abandoning the use of foot valves for priming purposes and are



substituting priming pumps. Since no water enters the pump, very little power is required, the cylinders and pistons are not subject to corrosion and operating strains are reduced to a minimum. No inlet valves are necessary since air enters the pump through ports which are alternately uncovered by the piston. Both exhaust valves are located at the cylinder ends, seated by a single spring and are always visible. All moving parts are automatically lubricated. The pump is a compact unit requiring little floor space or head room.

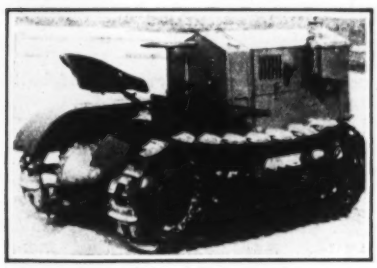
Structural Slate with Permanent Colored Finish

A product that has been developed to meet the needs of architects and builders who desire a colored material containing the sanitary, durable and economical characteristics of natural slate is known as Struco slate and is manufactured by the Structural Slate Co., Pen Argyl, Pa. It is a natural slate to which a hard and permanent colored finish has been applied by air pressure. The slate is given three or four coats, each successive application penetrating and becoming a part of its predecessor. It is claimed that the finish will not crack, chip or peel and in reality becomes an integral part of the slate itself. The product may be obtained in white, French gray, olive green and "spattered" finishes, the last resembling different kinds of granite.

Crawler Tractor Develops High Draw-Bar Pull

The new model K crawler tractor, manufactured by the Cleveland Tractor Co., Cleveland, Ohio, is claimed to develop a drawbar pull of 3,500 lb., while the total weight of the equipment is only 3,900 lb. In addition to this feature, the tractor is sturdily constructed. The use of seven closely assembled lower track wheels eliminates any rocking motion of the tractor and insures that a maximum amount of track grips the ground. The track wheels are mounted in cast iron bearings, which will not burn out and which require no adjustment. Adjustment of the crawler tracks is accomplished by a regulating screw which gives uniform alignment front and rear. The transmission case contains all the driving and reduction gears, leaving only a plain sprocket wheel outside for driving the tracks. The two adjusting bearings in the differential are taper roller bearings; the balance are ball bearings.

It is claimed that this is the only tractor containing a so-called instantaneous oiling system. By means of this system, the lower track wheels may be oiled by simply pushing a hand plunger conventiently located in front of the driver's seat. The side frame is a hollow steel casting and gives complete protection to this oiling system. Accessibility is an especially important feature of this new tractor. The power unit has two speeds forward and one



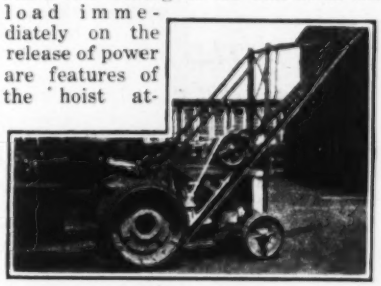
reverse. It is a four-cylinder engine, with a 4-in. bore and 5½-in. stroke.

The tractor develops 15 hp. at the drawbar and 25 hp. at the take-off; the drawbar pull is 3,500 lb. at 2¼ m.p.h. and 2,200 lb. at 4½ m.p.h. Overall dimensions are 99 in. long, 48 in. wide and 52 in. high; center to center of tracks 39 in., with 9½-in. track shoes.

Convertible Hoist and Shovel Attachment for Fordson

A new piece of Fordson equipment manufactured by the Squier-Rix Co., Milwaukee, Wis., is a structural steel frame and boom arranged for either hoist or shovel attachment. The frame is applied to the Fordson without drilling any holes or in any way altering the mechanical construction of the tractor. The equipment is available with steel wheels, rubber-tired wheels, or crawler traction mounting.

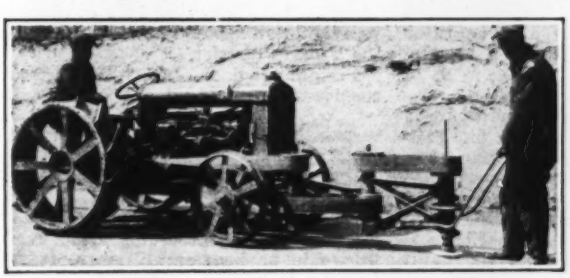
The power is transmitted from the regular Fordson take-off by means of a belt. The elevating mechanism is of a double-pulley and cable type equipped with an 8x8-in. drum. The hoist is built with lifts of 5, 8, 10, 12 and 14 ft. and for a maximum capacity of 2 tons being regularly equipped with a ballast box on the rear of the frame. A limit switch to prevent over-hoisting and a self-locking device that holds the load immediately on the release of power are features of the hoist attachment. Operation is by means of a lever placed near the driver's seat.



The shovel attachment consists of a heavy dipper stick and steel dipper mounted between the channels of the boom. In operating, the dipper is filled by being pushed into the pile by the tractor with the lip of the dipper slightly below the level of the front tractor wheels. A heavy bumper is constructed in front of the tractor which is used to force the dipper into the pile and place all the strain upon the main frame of the tractor. The shovel attachment used with the standard 8-ft.-lift hoist has a dipper clearance for wagon and truck loading. The standard dipper capacity is ½ yd. but a coal dipper of approximately ½-yd. capacity is also manufactured. The steering of the tractor is not interfered with by this equipment and a carrying capacity of 1,500 to 3,000 lb. is available depending upon the amount of ballast carried.

Grinding Machine Removes High Spots on Concrete Roads

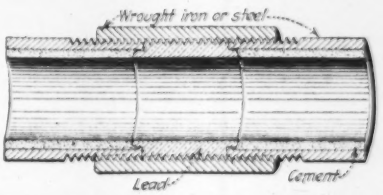
The removal of high spots is a prerequisite to the acceptance of most concrete pavements, and a machine which accomplishes this by a grinding action has been invented and is now in production by Ham & Westing, road and street contractors, Grand Rapids, Mich. The machine is being used with exceptionally good results by the Michigan State Highway Department on the new concrete paving work in the state. It is known as the Acme road grinder, is belt-driven from a Fordson tractor, and requires two men to operate it. The actual grinding is done by a grinder head, composed of 50 pointed steel cutters rotating at high speed on the end of a vertical shaft. This grinder head is guided by one of the men, while the other operates the tractor.



The grinder works with a double-swing arm in a semi-circle 8 ft. in diameter without moving the tractor. It has a screw-head adjustment for raising and lowering the grinder head, and there is a slight swivel joint between the head and the propelling shaft which allows the head to make even contact with the pavement. The machine is attached to the Fordson by two steel braces which can be applied to or removed from the tractor in 30 min.

Cement Lining in Wrought Iron and Steel Pipe

For use wherever corrosive waters of any kind are encountered, the Cement Lined Pipe Co., Lynn, Mass., is manufacturing steel and wrought iron pipe lined with a thin coating of cement. The pipe is available in sizes of from ¾ to 4 in. A continuous lining is made at the joints by using a standard fitting in which is placed a special shaped lead lining. As shown in the illustration,



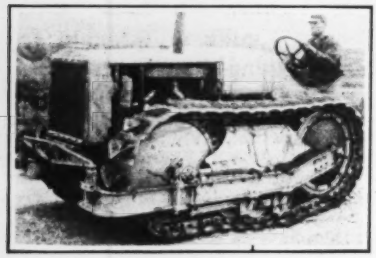
the lead has a lip on its inner circumference which extends into the pipe lapping a similar lip in the cement lining. Both the lead and cement lining are guaranteed against injury from shipping or handling.

Flexibility Is Feature of 5-Ton Crawler Tractor

Special efforts have been made to secure long life, comfort, mobility and maximum developed drawbar-pull by means of flexible construction in the new model "55" crawler tractor of 5-ton rating, manufactured by the Mead-Morrison Mfg. Co., Boston, Mass. Elasticity of the track design is supplied by four spiral springs mounted between the track frame and the tractor, on which rests practically the entire weight, thus causing the track to conform along its entire length to any irregularities of the ground surface. Lateral flexibility is secured by connecting each track by means of coil springs to an oscillating bar pivoted on the front of the engine frame, as may be seen in the illustration. This construction allows one track to rise 12 in. higher than the other. The track shoes are of manganese steel connected by chrome-nickel pins.

The engine is manufactured by the Stearns Motor Mfg. Co. and develops 36 hp. for normal working conditions with a 50 per cent reserve as a safety factor in emergencies. The radiator is of a special de-

sign composed of six sectional cooling elements. In case of damage, only the injured section need be replaced and in an emergency the damaged section can easily be plugged-out temporarily and the tractor kept in operation. The normal high speed of the tractor is 5 m.p.h. A novel and important feature of this machine is the drawbar attachment. Instead of being placed on the rear of the frame,



it is located forward of the center of the tractor and below the center of gravity. The drawbar pull is thus transmitted directly from the track. Equalizer bars place equal tension in the drawbar cables.

The overall dimensions of the tractor are 63x124 in. and the weight is 8,700 lb. A closed model is also manufactured for winter use whose weight is 9,250 lb.

One-Man Motor Patrol Grader

A sturdily built road grader incorporating an independently controlled scarifier all built around a Fordson power plant is a new product of the Russell Grader Mfg. Co., Chicago. Features of the equipment are fully machined gears, bronze bearings and collars, take-up bearing on the lift shaft, one wheel adjustment for the scarifier and Alemite lubrication. The frame is made from a 7 in. channel heavily braced and the steel platforms

are of checkered steel plate. The blade is fully reversible and may be tilted forward and backward from a leveling to a cutting position. Blades in 8, 10 or 12 ft. widths are available. The front wheels are equipped with 32x3½ in. rubber tires, while 40x5 in. dual-cushion tires are used on the rear. The motor is equipped with a governor to insure uniform speed under all cutting conditions. The spread of the front wheels is 51 in. and the wheelbase is 14 ft. 5 in. The weight of the outfit complete is 8,050 pounds.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

This Week's Contracts—Week Ago—Same Week Last Year

THE money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks.

Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial buildings.

Money Value of Contracts Let—Entire U. S.

Week Ending	Public Work	Private Work	Total Contracts
October 15, 1925	$ 9,731,000	$21,413,000	$31,144,000
October 8, 1925	29,372,000	31,107,000	60,479,000
October 16, 1924	13,291,000	17,012,000	30,303,000
Heaviest Week			
1925, Sept. 3	16,215,000	69,424,000	85,639,000
1924, May 8	26,370,000	38,829,000	65,199,000
January 1 to Date			
1925	862,419,000	1,168,638,000	2,031,057,000
1924	811,469,000	826,981,000	1,638,450,000

Output of Materials Far Ahead of Last Year

Present Balanced Relationship Existing Between Production and Shipments Serves as Restraining Influence Upon Rising Costs

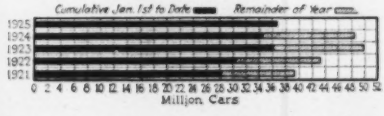
The first impresion to be gained from an examination of the regular monthly production statistics is, that with all this bulk of material on hand, an active winter construction program must be anticipated by the manufacturers.

Unprecedented production and shipment of cement, and the greater volume of brick and lumber business, compared with a year ago, all point to a prolongation of the building boom.

Steel making, while it shows the expected pick-up from the usual midsummer dullness, is considerably ahead of this time last year.

Regular reports to *Engineering News-Record* regarding conditions at dealers' warehouses throughout the country, show that basic building materials are plentiful. This is particularly true of the districts comprising New York, Philadelphia, Atlanta, Detroit, Minneapolis and New Orleans. The supply being ample but not to a point of excess, no pronounced fluctuations are looked for in prices of materials. This is taking into consideration the brisk demand now coming from the Florida district.

Freight loadings, Jan. 1 to date, are considerably ahead of the corresponding period in any preceding year. Traffic would be heavier still were it not for the anthracite coal strike and the freight-jam in transportation of building materials in the Florida boom area.



Taking four of the most important construction materials separately, the situation is as follows:

Steel—Ingot production, calculated by the American Iron and Steel Institute, was 3,492,904 tons in September, against 3,424,034 for the month preceding and 2,827,625 during the corresponding period last year. The output for the first nine months of this year was over 18 per cent ahead of the same period in 1924.

MONTHLY INGOT OUTPUT—ALL COMPANIES

	1924 Tons	1925 Tons
January	3,649,913	4,198,564
February	3,826,246	3,756,243
March	4,206,699	4,198,520
April	3,348,466	3,687,524
May	2,640,034	3,458,253
June	2,065,676	3,207,056
July	1,877,789	3,087,590
August	2,552,891	3,424,034
September	2,827,625	3,492,904

Unfilled orders on books of the U. S. Steel Corporation, Sept. 30, gained 204,494 tons over those on hand Aug. 31, thereby showing the first increase since February, 1925. The following comparison of booking shows the situation as to steel demand:

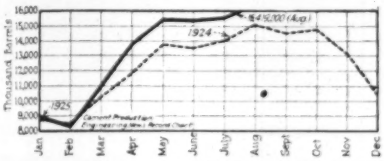
Sept. 30, 1925 Tons	Aug. 31, 1925 Tons	Sept. 30, 1924 Tons
3,717,297	3,512,803	3,473,780

Lumber—Production, shipments and demand, Jan. 1 to date, are all substantially ahead of the corresponding

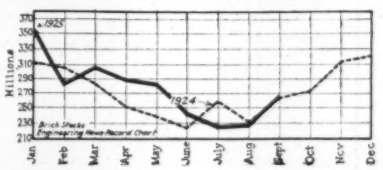
period last year. The following tabulation compares the national lumber movement for the three weeks indicated:

	Week Ended Oct. 3 Ft. b.m.	Corresponding Week in 1924 Ft. b.m.	Preceding Week in 1925 Ft. b.m.
Production	234,787,027	230,114,433	234,622,962
Shipments	233,761,304	228,000,867	246,388,043
New Business	217,124,526	200,623,057	228,463,502

Cement—Production and shipments during August were the highest ever recorded for any single month in the history of the industry, according to the Bureau of Mines. From the current month to possibly February, 1926, the output will show a steady seasonal decline, with shipments receding proportionately. Mill stocks will evidently pile up consistently from now until March of next year.



Brick—Reports of the Common Brick Manufacturers' Association, dated Oct. 1, show the industry to be substantially ahead of its position at this time last year. Fewer plants are closed down, there are more burned and un-burned brick on hand at yards throughout the country, shipments from yards are heavier, and orders on books show a greater volume than a year ago.



Chicago leads all other cities in brick consumption, it being estimated that over a billion and a quarter of common brick, to say nothing of the vast quantities of face brick, will represent the 1925 requirements for that city alone. Despite the strike in the Connecticut yards, production is getting back into line. New York, Philadelphia and Florida are taking considerable quantities of this material. All the brick going into Florida construction comes from the Southeastern district, comprising Alabama, Georgia, North and South Carolina and Louisiana. Up to the present time no clays suitable for brick making have been discovered in Florida. The brick situation, at yards throughout the country, is shown by the following tabulation:

1924	Burned Brick on Hand M	Unburned Brick on Hand M	Brick Moved from Yards During Month M	Orders on Books M
Sept. 1	261,800	68,138	120,777	256,017
1925				
Jan. 1	354,477	51,162	118,759	202,906
Feb. 1	279,862	23,951	94,185	201,479
Mar. 1	305,831	34,891	110,790	247,176
Apr. 1	287,800	43,446	170,697	329,673
May. 1	281,858	71,266	206,551	339,629
June 1	239,389	67,480	180,851	333,967
July.. 1	225,401	82,987	173,215	326,226
Aug. 1	227,306	92,267	180,407	292,775
Sept. 1	265,897	89,608	159,309	301,913

Unit Prices on Recent Large Jobs

Subway—Rochester, N. Y.

FOLLOWING are lowest three bids opened by Bd. Contract & Supply, Mar. 25, for subway from Oak St. to Mt. Read Blvd., Contr. No. 3 (A) I. M. Ludington's Sons, Inc., 123 Powers Bldg., (awarded contract); (B) Frank L. Cohen; (C) Thomas J. Dolan. The unit bids are as follows:

	A	B	C
255,000 cu.yd earth excavation in grading	$1.15	$1.50	$1.20
10,000 cu.yd. earth excavation in trenches and pits	2.00	1.75	2.00
60,000 cu.yd. rock excavation in grading	3.00	4.00	4.00
10,000 cu.yd. rock excavation in trenches and pits	5.00	7.00	6.00
1,000 cu.yd. bridge masonry excavation	5.00	5.00	6.00
5,000 sq.yd. removing old pavement and walks	1.50	.20	1.25
25,000 cu.yd forming embankment	.30	.40	.65
1,000 sq.yd. slope walls and paving in place	5.00	4.00	5.00
300 cu.yd. Class "A" concrete in place	30.00	22.00	30.00
4,000 cu.yd Class "B" concrete in place	22.50	23.00	20.00
48,000 cu.yd. Class "C" concrete in place	12.00	12.50	12.00
2,000 cu.yd. Class "D" concrete in place	8.00	10.00	10.00
60,000 lin.ft. line drilling	.25	.25	.35
1,000 lin.ft. jack hammer drilling	.30	.35	.30
5,000 lin.ft. 4-in. galvanized iron weepers	.40	1.00	.50
1,300 lin.ft. concrete railing	12.00	12.00	15.00
1,000 lin.ft. metal railing bridge approaches	6.00	6.00	6.50
500 lin.ft. 2-in. pipe hand railing	3.25	3.00	3.50
50 M ft. b.m. timber for temporary bridges, walks and fences	120.00	80.00	117.50
10 M ft. b.m. sheeting and bracing in place	75.00	60.00	70.00
10 M ft. b.m. timber in place underpinning walls	100.00	120.00	105.00
1,125,000 lb. structural steel in place	.05	.05	.07
213,500 lb. metal reinforcement in place	.05	.04	.06
10,000 lb. drawn wire	.05	.05	.05
43,000 lb. iron castings in place	.08	.07	.08
570 lin.ft. 6-ft. concrete pipe sewer, including cradle	17.00	25.00	25.00
3,120 lin.ft. 24-in. vitrified pipe sewer in place	3.25	3.25	3.25
1,340 lin.ft. 15-in. vitrified pipe sewer in place	1.75	1.75	1.75
7,300 lin.ft. 12-in. vitrified pipe sewer in place	1.25	1.25	1.25
200 lin.ft. 8-in. vitrified pipe sewer in place	.75	.75	.75
3,120 lin.ft. concrete cradle for 24-in. sewer in place	2.00	2.00	2.00
1,340 lin.ft. concrete cradle for 15-in. sewer in place	1.25	1.25	1.25
7,300 lin.ft. concrete cradle for 12-in. sewer in place	1.00	1.00	1.00
200 lin.ft. concrete cradle for 8-in. sewer in place	.50	.50	.50
5 Y branches for 24-in. sewer in place	8.00	5.00	8.00
5 Y branches for 15-in. sewer in place	3.00	3.00	3.00
5 Y branches for 12-in. sewer in place	2.50	2.50	2.50
5 Y branches for 8-in. sewer in place	1.75	1.75	1.75
54 sewer manholes, not over 8-ft. deep	100.00	100.00	100.00
150 lin.ft. sewer manholes, over 8-ft. deep	12.00	12.00	12.00
5 surface sewers complete, in intersecting streets	40.00	40.00	40.00
9,000 sq.yd. preparation of subgrade pavement in intersecting streets	.25	.15	.25
20,000 sq.ft. preparation of subgrade walks in intersecting streets	.05	.01	.05
3,200 lin.ft. 5-in. Medina stone curb in place	1.80	2.50	1.80
600 lin.ft. Medina stone curb, reset	1.20	1.00	1.20
3,000 lin.ft. 4-in. vitrified pipe tile under curb in place	.25	.20	.25
1,200 ton 2-in. asphalt wearing surface	14.00	10.00	14.00
700 ton asphalt binder course	7.50	7.00	7.50
500 sq.yd. Medina stone pavement wearing surface	5.00	4.00	4.50
100 sq.yd. Medina stone pavement relaid	3.00	2.25	2.50
500 sq.yd. brick pavement wearing surface	3.00	3.00	3.50
100 sq.yd. brick pavement wearing surface, relaid	2.00	1.00	2.50
500 sq.yd. 1-in. sand cushion Medina stone pavement	.10	.10	.10
500 sq.yd. 1-in. cement sand cushion brick pavement	.30	.25	.30
20,000 sq.ft. single course cement walks	.25	.15	.25
500 sq.ft. sidewalk relaid	.10	.10	.10
57 removing trees	25.00	10.00	25.00
1,364 gross tons rails delivered	55.00	57.00	60.00
3,100 pr. splice bars delivered	1.85	1.75	1.80
15,000 lb. track bolts delivered	.06	.05	.06
12,500 nut locks delivered	.05	.02	.02
90,000 lb. track spikes delivered	.06	.03½	.06
33,000 tie plates delivered	.50	.25	.50
15,000 special tie plates for guard rails, delivered	.75	1.75	.75
3,100 rail joint plates delivered	2.70	1.25	2.75
3,000 rail braces delivered	.60	1.00	.55
3,000 rail braces installed	.15	.10	.20
7,000 anti-creepers delivered	.40	.15	.35
7,000 anti-creepers installed	.10	.05	.15
200 gross ton guard rail delivered	90.00	100.00	100.00
15,000 lin.ft. guard rails installed	1.25	.70	1.25
31 switches delivered	125.00	25.00	120.00
31 switches installed	100.00	75.00	105.00
1 No. 7 double spring frogs delivered	130.00	110.00	130.00
9 No. 7 single spring frogs delivered	120.00	95.00	120.00
7 No. 9 double spring frogs delivered	140.00	100.00	140.00
14 No. 9 single spring frogs delivered	130.00	100.00	130.00
31 frogs installed	50.00	50.00	50.00
5 derails complete in place	60.00	50.00	60.00
25,000 cu.yd. ballast in place	2.50	2.25	3.75
27,000 track ties delivered	2.60	2.60	3.00
25,000 lin.ft. track laying on tangent and curves having a radius of 2,000 ft. or greater	1.30	1.00	1.15
18,000 lin.ft. track laying on curves having a radius less than 2,000 ft. and greater than 700 ft.	1.30	1.20	1.60
8,500 lin.ft. track laying, curves radius of 700 ft. or less	1.30	1.30	1.80
492 lin.ft. station covers	25.00	20.00	25.00
220 lin.ft. stairway covers—horizontal protection	45.00	40.00	45.00
2,850 lin.ft. 6-in. c.i. pipe track drains in place	1.50	1.60	1.50
140 catch basins in track drains, complete	40.00	30.00	40.00
10,000 lin.ft. fencing complete in place	.75	.60	1.00
200 cu.yd. cinder fill under walks	2.00	2.00	4.53
900 lin.ft. safety treads for stairways	1.20	2.00	1.20
84 M ft. b.m. treated timbers for switches	90.00	100.00	125.00
Clearing (lump sum)	2,000.00	2,500.00	1,000.00
Bailing and draining (lump sum)	20,000.00	4,000.00	16,000.00
Care of surface drainage and sewage (lump sum)	2,000.00	5,000.00	2,000.00
Maintaining traffic (lump sum)	5,000.00	4,000.00	20,000.00
Removing bridges (lump sum)	5,000.00	8,000.00	5,000.00
Extended totals	$1,937,811	$2,073,949	$2,122,991

Subway, New York, N. Y.

FOLLOWING are lowest three bids opened by Board of Transportation, 49 Lafayette St., Sept. 8, for Route No. 102, Sect. No. 6, along 8th Ave. and Central Park West from 58th to 68th Sts., (A) Frederick L. Cranford, Inc., 149 Remsen St., Brooklyn; (B) Coleman Bros., Inc., 80 Maiden Lane; (C) Underpinning & Foundation Co., Inc., 342 Madison Ave. This job was awarded to F. L. Crawford, Inc. at $5,889,649. The unit bids are as follows:

	A	B	C
†140,300 cu.yd. earth excavation, dump furnished by B. of T	$12.00	$13.00	$14.25
*140,300 cu.yd. earth excavation, contractor's disposal	12.20	14.00	15.25
†123,700 cu.yd. rock excavation, dump furnished by B. of T.	12.00	13.00	14.25
*123,700 cu.yd. rock excavation, contractor's disposal	12.20	14.00	15.25
1,050 lin.ft. removal and restoration of C.P. stone wall fence	12.00	10.00	100.00
Maintaining and supporting comfort station at 61st St. (lump sum)	9,900.00	14,000.00	6,000.00
Underpinning, 989 Eighth Ave. (lump sum)	2,625.00	5,000.00	5,000.00
Underpinning, N. W. cor. 8th Ave. and 58th St. (lump sum)	3,900.00	7,500.00	8,000.00
Underpinning, C.P.W. bet. 60th and 61st Sts. (lump sum)	25,400.00	28,000.00	28,000.00
Underpinning, 13-16 Central Park West (lump sum)	7,500.00	20,000.00	.....
Underpinning, 17-21 Central Park West (lump sum)	6,000.00	20,000.00	15,000.00
Underpinning, N. W. cor. 65th St. and Central Park West (lump sum)	6,500.00	20,000.00	33,000.00
Underpinning, 55 Central Park West (lump sum)	7,500.00	10,000.00	15,000.00
38 furnishing and setting trees	50.00	40.00	100.00
29,000 cu.yd. concrete masonry	21.00	23.00	26.00
177,000 sq.ft. rubbing to smooth finish the surface of concrete	.15	.13	.20
4,000 cu.yd. protective concrete masonry	21.00	23.00	26.00
700 cu.yd. rubble stone masonry	12.00	10.00	25.00
25 cu.yd. dry rubble masonry	11.00	9.00	24.00
100 cu.yd. brick masonry	40.00	50.00	65.00
220 cu.yd. removal of old masonry	75.00	40.00	100.00
100 sq.yd. vitrified brick lining for sewers	6.00	4.00	7.00
20 cu.yd. hollow terra cotta brick or tile	50.00	40.00	65.00
100 bbl. grout of Portland cement	8.00	8.00	6.00
100 sq.yd. resurfacing old concrete masonry	5.00	2.00	5.40
200 sq.yd. plastering on hollow tile	1.50	1.25	3.00
10 cu.yd. broken stone or gravel	5.00	5.00	6.00
17,300 sq.yd. waterproofing, one ply	1.50	1.25	1.25
12,700 sq.yd. waterproofing, three ply	2.50	2.50	3.50
800 sq.yd. waterproofing, five ply	5.00	3.50	5.00
3,000 sq.yd. waterproofing, six ply	6.00	5.00	6.00
100 sq.yd. waterproofing, dry	1.30	1.00	1.25
700 cu.yd. waterproofing, brick in asphalt mastic, 1 layer	55.00	40.00	60.00
1,450 cu.yd. waterproofing, brick in asphalt mastic, 2 layer	50.00	35.00	60.00
550 lin.ft. 3-in. cast iron pipe and fittings	1.50	1.00	2.00
1,000 lin.ft. 6-in. cast iron pipe and fittings	2.00	2.00	4.00
3,000 lin.ft. 8-in. cast iron pipe and fittings	3.00	3.50	5.00
180 lin.ft. 10-in. cast iron pipe and fittings	4.50	5.00	6.00
500 lin.ft. 3-in. standard galvanized steel pipe	2.00	1.50	2.00
200 lin.ft. 6-in. standard galvanized steel pipe	2.00	3.00	4.00
70 lin.ft. 8-in. standard galvanized steel pipe	6.00	4.00	5.00
60 lin.ft. 10-in. standard galvanized steel pipe	7.00	5.00	6.00
160,000 duct ft. tunnel ducts	.30	.25	.40
360 cond.ft. 3-in. fibre conduits	.40	.50	.50
3,660 ton riveted steel	120.00	125.00	150.00
12 ton cutting and disposal of old steel	200.00	100.00	100.00
38 W.I. tree guards and gratings	20.00	20.00	20.00
3-ton architectural iron and steel	425.00	400.00	500.00
565 sq.ft. sliding doors with steel panels	6.00	6.00	7.00
2 counterbalanced emergency exit covers	500.00	500.00	600.00
2,050 ton steel beams and shapes	120.00	125.00	150.00
250 drilling holes in steel	2.00	4.00	2.00
130 ton steel rods and bars	110.00	100.00	150.00
22 ton miscellaneous iron castings	200.00	200.00	300.00
1,850 lb. special wire forms	.30	.15	.40
4,500 lin.ft. 1½-in. oak or ash handrail	.75	.50	1.00
3,900 sq.ft. horizontal steel gratings for ventilation	3.50	4.00	5.00
960 sq.ft. vertical steel gratings for ventilation	5.00	4.00	5.00
5,000 sq.yd. sidewalk restored	3.00	2.00	5.00
8,250 sq.yd. roadways restored—asphalt	4.00	5.00	6.00
1,550 sq.yd. roadways restored—granite block	4.00	6.00	5.00
2,900 sq.yd. roadways restored—wood block	5.00	5.00	6.00
3,450 sq.yd. roadways restored—Belgian block	5.00	5.00	4.00
100 lin.ft. new 6-in. bluestone curb	3.50	3.00	3.50
150 lin.ft. new 8-in. granite	6.00	3.50	6.00
10 sq.yd. new sidewalk finish, 3-in. thick	4.00	3.00	9.00
16,150 sq.yd. temporary pavement of granite blocks	3.00	3.00	4.50
1,700 sq.yd. park surface restored	3.00	2.00	3.00
20,000 lin.ft. ¾-in. steel electric conduits	.60	.50	.30
50 lin.ft. 1½-in. steel electric conduits	1.00	1.00	1.00
13,000 lin.ft. 1-in. steel electric conduits	.70	.50	.40
10 lin.ft. 2½-in. steel electric conduits	3.00	2.00	1.50
1,410 cast iron outlet boxes, 4x4x3 in.	2.50	2.00	3.00
10 cast iron pull boxes, 6x6x4 in.	6.00	10.00	6.00
1 cast iron pull box, 6x12x3 in	15.00	25.00	12.00
175 lin.ft. 6-in. cast iron pipes and fittings "Extra Heavy"	3.00	2.50	5.00
150 lin.ft. 3-in. cast iron pipes and fittings, "Extra Heavy"	3.00	1.50	3.00
50 lin.ft. 4-in. cast iron pipes and fittings "Extra Heavy"	4.00	2.00	4.00
1,300 lin.ft. 12-in. vitrified pipe sewer	7.00	6.00	10.00
700 lin.ft. 15-in. vitrified pipe sewer	7.00	8.00	11.00
20 ton cast iron sewer pipe (straight pipe)	250.00	100.00	180.00
10 ton cast iron sewer pipe (special castings)	300.00	200.00	270.00
1,250 lin.ft. flat top reinforced concrete sewers 3 ft. 6 in. x 2 ft. 4 in.	22.00	20.00	36.00
600 lin.ft. flat top reinforced concrete sewers 4 ft. x 2 ft. 6 in.	22.00	25.00	40.00
100 lin.ft. flat top reinforced concrete sewers 3 ft. 9 in. x 2 ft. 4 in.	22.00	25.00	50.00
5,000 lin.ft. electric (underground trolley) railroad (single track)	10.00	10.00	25.00
Support and maintenance of Man. Bronx R. T. R. and Columbus Monument (lump sum)	345,000.00	35,000.00	300,000.00
100 lin.ft. water pipe, 6 in.	4.00	2.00	3.00
100 lin.ft. water pipe, 12 in.	5.00	4.00	5.00
700 lin.ft. water pipe, 20 in.	6.00	7.00	7.00
200 lin.ft. water pipe, 30 in.	15.00	13.00	10.00
10 service connections for water pipes	50.00	50.00	60.00
100 lin.ft. gas pipe, 6 in.	3.00	2.00	3.00
200 lin.ft. gas pipe, 10 in.	3.50	3.00	5.00
700 lin.ft. gas pipe, 20 in.	10.00	7.00	7.00
100 lin.ft. gas pipe, 30 in.	15.00	20.00	10.00
100 lin.ft. gas pipe, 36 in.	20.00	30.00	12.00
400 lin.ft. steel by-passing pipe, 6 in.	5.00	10.00	8.00
1,500 lin.ft. steel by-passing pipe, 8 in.	6.00	13.00	9.00
1,200 lin.ft. steel by-passing pipe, 10 in.	12.00	15.00	10.00
700 lin.ft. steel by-passing pipe, 12 in.	12.00	17.00	12.00
50 lin.ft. steel by-passing pipe, 16 in.	15.00	20.00	25.00

(Continued on p. 657)

Trend In Industrial Building Methods Shown By Survey

Practice of Having One Firm of Engineers and Builders Design and Construct a Factory, Gaining

That manufacturers, large and small, are working toward a point where they will all prefer to have a firm of engineers and builders both design and erect their new buildings, is emphasized in a survey of the industrial building situation conducted by the John B. Abell Organization of Cleveland.

A similar investigation made less than ten years ago showed that "practically all manufacturers erected their own buildings and additions themselves or under the supervision of an architect and upon his design, or made the drawings and let the contracts themselves."

The questionnaire sent out, covered 1,548 industrial firms manufacturing every conceivable product and drew 1,225 answers from executives of these concerns. The survey is therefore typical of the general trend of factory construction.

The questions were presented in the following manner:

(1) We prepare our own drawings and erect our own buildings.

(2) We prepare our own drawings but let the construction to outside builders.

(3) We prefer to have an outside architect design and supervise the erection of our new buildings.

(4) We prefer to have a firm of engineers and builders both design and erect our new buildings.

The report further states:

"In our survey we found that at the present time 318 firms prefer to have one engineering and building company both design and erect the entire job; that 256 manufacturers prepare their own drawings and erect their own buildings; that 192 others prepare their own drawings but let the construction to outside builders and that 376 firms employ outside architects for the design and supervision of new construction. Thus of the 1,225 answers received 1142 expressed a preference for one of the four methods mentioned. There were 44 firms indicating no preference, and 39 others giving miscellaneous answers.

"The figures thus compiled indicate that the older methods of arranging for industrial construction are fast passing into the discard. The newer method of employing a firm of engineers and builders to both design and erect factories has come up from practically a position of zero, less than a decade ago, to one of leadership over all other methods. The procedure whereby the manufacturer designed and erected his own building, or where he prepared his drawings but let out the construction, have slipped from dominance on the occasion of the former survey to the bottom of the row at this time.

"Although the bare figures of our survey still indicate that the method

(Continued on p. 657)

Subway—New York, N. Y.

(Concluded from p. 656)

4,500 lin.ft. steel by-passing pipe, 20 in.	20.00	23.00	30.00
25 lin.ft. steel by-passing pipe, 24 in.	25.00	30.00	50.00
50 lin.ft. steel by-passing pipe, 30 in.	30.00	40.00	60.00
75 lin.ft. steel by-passing pipe, 36 in.	30.00	50.00	72.00
25 lin.ft. steel by-passing pipe, 8 in. on trestle or cable	8.00	10.00	25.00
200 lin.ft. steel by-passing pipe, 16 in. on trestle or cable	18.00	20.00	25.00
900 lin.ft. steel by-passing pipe, 20 in. on trestle or cable	22.00	25.00	30.00
150 lin.ft. steel by-passing pipe, 24 in. on trestle or cable	26.00	30.00	30.00
175 lin.ft. steel by-passing pipe, 30 in. on trestle or cable	34.00	40.00	60.00
150 lin.ft. steel by-passing pipe, 36 in. on trestle or cable	38.00	50.00	72.00
175 lin.ft. trestle to support by-passing pipe	15.00	20.00	30.00
650 lin.ft. cable suspension to support by-passing pipe over 16 in. in dia.	10.00	20.00	30.00
10 service connections for gas pipe	50.00	40.00	60.00
200 ton new cast iron hub and spigot pipe, straight	125.00	100.00	180.00
100 ton new cast iron hub and spigot pipe, special castings	250.00	200.00	270.00
35,000 duct. ft. electric ducts and conduits	.45	.25	1.50
10 service connections for electric ducts	80.00	50.00	100.00
10 service boxes on relocated duct lines	250.00	75.00	250.00
5 junction boxes on relocated duct lines	500.00	250.00	500.00
1 additional junction box on relocated duct lines	750.00	300.00	700.00
*Totals, alternative "*a*"	$5,889,649	$5,949,890	$7,292,258
†Totals, alternative "*b*"	5,942,449	6,213,890	7,556,258

* Alternative "*a*" does not include items 1b and 3b.
† Alternative "*b*" does not include items 1a and 3a.

Street Grading—Philadelphia, Penn.

FOLLOWING are lowest three bids opened by Delaware River Bridge Joint Comn., Widener Bldg., July 15, for grading, paving and other work along Philadelphia approach from Delaware Ave. to 4th St., in connection with bridge over Delaware Ave. to 4th St., in connection with bridge over Delaware River between Philadelphia and Camden, Contr. No. 23 (A) Mazzola & Marano, 739 South 7th St. (awarded contract); (B) McNichol Paving & Construction Co., 1923 Cherry St.; (C) G. F. Dobbin Co., 1020 South 47th St. The unit bids on this job are as follows:

	A	B	C
850 cu.yd. excavation for structures	$3.00	$2.75	$2.00
58,000 cu.yd. street grading	1.35	.94	2.00
1,000 cu.yd. trench excavation	3.00	2.75	3.00
20 cu.yd. concrete masonry, grade "A," 1½ in. aggregate	30.00	23.00	25.00
130 cu.yd. concrete masonry, grade "A," ¾ in. aggregate	30.00	30.00	25.00
20 cu.yd. concrete masonry, grade B	20.00	20.00	20.00
100 cu.yd. concrete masonry, grade C	15.00	13.00	18.00
4,700 cu.yd. concrete base for roadway paving and repaving	9.50	8.30	10.00
17,300 lb. reinforcing steel	.06	.06	.05
32,000 lb. reinforcing steel for roadway paving	.06	.07	.06
Alterations to Frankford Elev. Ry. Structure (lump sum)	100,000.00	113,286.00	107,000.00
11,600 sq.yd. new granite block paving, not including concrete base	5.50	5.80	5.50
7,200 sq.yd. redressed stone block paving, not including concrete base	2.25	2.19	2.20
400 sq.yd. stone block repairing, not including concrete base	1.50	1.66	1.20
2,300 sq.yd. asphalt paving, not including concrete base	2.25	2.25	2.50
4,800 sq.yd. reinforced concrete paving	2.20	2.60	2.75
8,200 sq.yd. concrete sidewalk, without granolithic finish	2.25	2.39	2.50
2,600 sq.yd. granolithic sidewalk	2.50	2.69	2.50
3,200 sq.yd. crushed stone surfacing	1.00	.87	.65
2,600 sq.yd. cinder	.50	.18	.25
3,700 lin.ft. 6 in. straight granite curbing	3.00	3.00	2.75
2,500 lin.ft. 8 in. straight granite curbing	3.50	3.55	3.75
550 lin.ft. 6 in. curved granite curbing	3.50	3.60	3.75
850 lin.ft. 8 in. curved granite curbing	4.00	3.95	4.50
4,100 lin.ft. resetting curbing, 6- and 8- in.	1.00	.75	.50
45 cu.yd. Holmesburg granite retaining walls	20.00	20.00	30.00
500 cu.yd. rubble masonry	15.00	12.30	12.00
200 cu.yd rubble masonry underpinning	50.00	22.50	20.00
30 cu.yd brick masonry	35.00	35.00	30.00
20 thous. ft. B.M. short leaf yellow pine lumber	150.00	200.00	100.00
50 sq.yd. relaying brick sidewalk	1.50	2.75	.50
100 sq.yd. relaying flagstone sidewalk	1.00	2.75	.50
500 sq.ft. new steel plate sidewalk doors	2.35	2.33	2.00
240 sq.ft. new sidewalk gratings	2.60	2.59	2.40
7 resetting old sidewalk doors and gratings	15.00	15.00	10.00
23 resetting old coal hole covers and frames	5.00	12.00	6.00
110 reconnecting bldg. drainage to sewer	47.50	80.00	50.00
5,000 sq.ft. cleaning and plastering walls	30	.16	.25
5,000 sq.ft. cleaning and dashing walls	.20	.15	.20
100 sq.ft. cleaning and cut pointing walls	.25	1.00	.15
65 lin.ft. iron fence	5.00	3.25	3.10
20 lin.ft. 3 ft. diameter brick sewer stone block invert	45.00	48.00	33.00
365 lin.ft. 3 ft. diameter brick sewer vitrified shale brick invert	39.00	53.00	33.00
405 lin.ft. 3 ft. diameter brick sewer	38.00	46.00	33.00
175 lin.ft. 3 ft. by 2 ft. brick sewer vitrified shale brick invert	22.50	41.00	28.00
145 lin.ft. 2 ft. 3 in. by 1 ft. 6 in. brick sewer vitrified shale brick invert	19.00	35.50	20.00
100 lin.ft. 12 in. diameter vitrified clay pipe sewer in concrete cradle	14.00	20.00	10.00
100 lin.ft. 15 in. diameter vitrified clay pipe without concrete cradle	11.00	12.00	12.00
570 lin.ft. 12 in. diameter vitrified clay pipe without concrete cradle	8.00	8.90	10.00
30 lin.ft. 10 in. diameter vitrified clay pipe without concrete cradle	7.00	9.00	10.00
30 lin.ft. 8 in. diameter vitrified clay pipe without concrete cradle	6.00	8.00	8.00
1,450 lin.ft. 6 in. diameter vitrified clay pipe without concrete	2.25	6.50	2.00
5 brick manholes for sewers	175.00	175.00	100.00
5 No. 2 brick and stone inlets	210.00	200.00	100.00
19 No. 3 brick and stone inlets	200.00	180.00	100.00
600 sq.ft. ¼ in. premoulded expansion joint filler	.25	.19	.30
1,400 sq.ft. ½ in. premoulded expansion joint filler	.20	.15	.20
1,500 lin.ft. 6 in. water main	2.50	6.40	1.50
950 lin.ft. 8 in. water main	3.25	6.40	2.20
5 6 in. gate valves	35.00	68.00	35.00
2 8 in. gate valves	50.00	80.00	50.00
7 brick manholes for water main valves	35.00	40.00	30.00
70 reconnecting ¾- and 1 in. water service pipes	76.00	70.00	50.00
20 reconnecting 1–1¼ and 1½ in. water service pipes	95.00	70.00	50.00
4 reconnecting 2 in. water service pipes	125.00	70.00	100.00
2 reconnecting 3 and 4 in. water service pipes	175.00	80.00	200.00
3 lowering existing fire hydrants	20.00	80.00	50.00
100 ends cutting and redressing ends of existing curb	3.00	1.50	2.00
1 cast iron frame and cover for sewer manholes	20.00	22.58	16.00
Extended totals	$495,512	$509 60	$522,844

Trend in Industrial Building Methods Shown by Survey

(Concluded from p. 656)

by which industries employed an architect to both design and supervise construction, still tops the list by a small margin, an analysis of the facts shows that this procedure has suffered the greatest set back of all, during the time which has elapsed between the former investigation and the survey made by our research department. It must be remembered that less than a decade ago this method ran so far ahead in popular favor, as to make its present showing proportionately worse than that of the other two older construction procedures."

Carloadings Indicate Heavy Fall Trade

A reliable index of the volume of business being transacted throughout the nation, is found in the current report of the American Railway Association, covering freight loadings up to and including Sept. 26, 1925.

Over a million carloads of revenue freight per week were loaded and hauled between July 12 and Sept. 26, with the single exception of the week of Sept. 7, which was Labor Day.

The week of Sept. 26 is the latest period for which final returns are obtainable. These figures show substantial gains over the corresponding period last year in all classes of freight except grains, grain products and coal.

CARLOADS OF REVENUE FREIGHT

Week Ended	1925	1924	1923
Sept. 26	1,120,645	1,087,447	1,097,493
Sept. 19	1,098,428	1,076,847	1,060,811
Sept. 12	975,434	1,061,781	1,060,563
Sept. 5	1,102,946	921,303	928,916
Aug. 29	1,124,436*	1,020,809	1,092,150
Aug. 22	1,080,107	982,760	1,069,915
Aug. 15	1,064,793	953,408	1,039,938
Aug. 8	1,051,611	941,407	973,750
Aug. 1	1,043,063	945,613	1,033,466
July 25	1,029,603	926,309	1,041,415
July 18	1,010,970	930,713	1,029,429

*Heaviest single week on record.

Compared with the same week in 1923, loadings were greater in all classes except live stock, coal, coke, forest products and ore.

The persistent gain in movements of merchandise in less-than-carlot quantities, over those of the past two years, is an accepted indication of the comparative prosperity of the small shipper.

Increase in Steel Ship Building—Fewer Wooden Vessels

On September 1, 1925, American shipyards were building or were under contract to build for private shipowners 140 steel vessels of 148,127 gross tons compared with 74 steel vessels of 148,100 gross tons on August 1, 1925, according to the Bureau of Navigation, Department of Commerce.

There were 12 wood vessels of 6,555 gross tons being built or under contract for private shipowners during the same period, compared with 13 wood vessels of 8,767 gross tons on August 1, 1925.

Weekly Construction Market

WITH prices of basic building materials showing more signs of stability than in several weeks past, attention is now drawn to the labor situation.

The settling of the recent jurisdictional dispute between bricklayers and plasterers, which tied up over $250,000,000 worth of construction, by a return to the original agreement of 1911, has removed one of the most serious problems with which the construction industry has had to deal.

Now comes the prospect of higher wage schedules for 1926, which, it is believed, will be demanded by building trades mechanics in several important centers. Apprehension in this direction is particularly great in New York City, where keen competitive bidding has cut down builders' profits to a very great extent.

Wages of skilled building mechanics in New York City are approximately 17 per cent above the average for the nation, while those of unskilled common laborers are about 20 per cent higher than the U. S. average. For the country, as a whole, skilled building trades wages are about 2 per cent above a year ago, while the common laborers' rate is 4 per cent below the average for October, 1924.

With money value of contracts, Jan. 1 to Oct. 1, 20 per cent ahead of a year ago; actual physical volume close to the record level; cost of living tending upward; prices of wholesale commodities about 2 per cent above this time last year; and a declining tendency in the purchasing value of the dollar, it is not strange that the mechanics should mobilize for the purpose of obtaining higher wages.

Assuming that the building shortage has been made up and that present construction activity is the expression of a new and greater demand, an advance in skilled wages at this time might serve as a brake against any further progress of the industry at its present rate.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb	$3.34	$3.90	$4.00	$3.10	$3.35	$3.07½	$3.30	$3.35	$4.25
Structural rivets, 100 lb	4.50	4.45	4.75	3.50	3.75	4.65	5.00	3.75	6.00
Reinforcing bars, ¾ in. up, 100 lb	3.24	3.40	2.80	3.00	3.25	3.77½	3.35	3.25	2.30
Steel pipe, black, 3½ to 6 in. lap, discount	48%	54%	53.6%	51%	54.25%	36%	39.2@51%	50%	59.49
Cast-iron pipe, 6 in. and over, ton	50.60@51.60	46.40	54.00	49.20@50.20	53.00	63.00	—53.00	55.00	55.00
Concreting Material									
Cement without bags, bbl	2.50@2.60	2.25	2.05	2.20	2.42	2.84	2.31	2.65	1.80
Gravel, ¾ in., cu.yd	1.75	2.20	2.38	2.00@2.20	1.65	1.90	2.15	1.50	1.25
Sand, cu.yd	1.00	1.65	2.00	2.00@2.20	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.85	2.20	2.83	2.00@2.20	1.75	2.50	2.15	3.00	1.90
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	61.00	34.00	58.50	53.50	—35.75	33.75	27.00	25.00	60.00
Lime, finishing, hydrated, ton	18.20	22.50	18.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl	2.25@2.75	1.30	1.85	1.30	1.35	2.70	1.60	2.80	9.50
Common brick, delivered, 1,000	17.50@18.00	10.50	11.60	12.00	13.50	12.00	15.50	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.0893	.10	.075	.....	.085	.....	.10	.12
Hollow partition tile 4x12x12, per block	.1027	.0893	.10	.075	.07	.085	.108	.10	.10
Linseed oil, raw, 5 bbl. lots, gal	1.04½	1.09½	1.13	—1.01	1.11	—1.22	1.15	1.12	1.25
Common Labor									
Common labor, union, hour	.55@.75	.30	.....	.87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	.82½	.45@.55	.35@.50	.50	.50	.25@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Labor—Concrete laborers' rate, 93¾c.; building laborers, 75c.; excavating laborers, 55c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone delivered on job; pine is 4-in. instead of 3-in.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of October 1, the next on November 5.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 100.125). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3½-in., $59.49.

Business Briefs

Call money quoted at 4½ per cent, Oct. 9; year ago, 2½ per cent.

Time loans: short terms, 4½@4¾ per cent; longer periods, 4¾@5 per cent.

Commercial paper: best names, 4½ per cent; other names, 4¾ per cent.

On October 1, 1925

E. N.-R. Construction Cost Index Number 205.35

E. N.-R. Construction Volume Index Number 262

For Explanation and Details of Indexes Since 1913 See the First Issue of Every Month